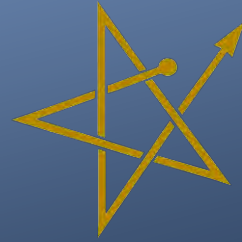


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**NPRST-TR-15-4**

**September 2015**

## **An Ultimatum Game Approach to Billet Assignments**

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**Michael McKee, Ph.D.**

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| REPORT DOCUMENTATION PAGE   |              |                  | Form Approved<br>OMB No. 0704-0188 |  |
|---|--------------|------------------|------------------------------------|--|
| Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. <b>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</b>   |              |                  |                                    |  |
| 1. REPORT DATE (DD-MM-YYYY)   |              | 2. REPORT TYPE   |                                    | 3. DATES COVERED (From-To)               |
| 17-09-2015  |              | Technical Report |                                    | November 2013-October 2014               |
| 4. TITLE AND SUBTITLE   |              |                  |                                    | 5a. CONTRACT NUMBER                      |
| An Ultimatum Game Approach to Billet Assignments  |              |                  |                                    | 5b. GRANT NUMBER                         |
|   |              |                  |                                    | 5c. PROJECT ELEMENT NUMBER               |
|   |              |                  |                                    | 5d. PROJECT NUMBER                       |
| 6. AUTHORS  |              |                  |                                    | 5e. TASK NUMBER                          |
| David McEvoy, Ph.D.<br>Michael McKee, Ph.D.<br>Todd Cherry, Ph.D.<br>Michael Jones, Ph.D.<br>Tanja F. Blackstone, Ph.D.   |              |                  |                                    | 5f. WORK UNIT NUMBER                     |
|   |              |                  |                                    |  |
|   |              |                  |                                    |  |
| 7. PERFORMING ORGANIZATIONS NAME(S) AND ADDRESS(ES)   |              |                  |                                    | 8. PERFORMING ORGANIZATION REPORT NUMBER |
| Navy Personnel Research, Studies, & Technology (NPRST/BUPERS-1)<br>Bureau of Naval Personnel<br>5720 Integrity Drive<br>Millington, TN 38055-1000   |              |                  |                                    | NPRST-TR-15-4                            |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)   |              |                  |                                    | 10. SPONSOR/MONITOR'S ACRONYM(S)         |
|   |              |                  |                                    | 11. SPONSOR/MONITOR'S REPORT NUMBER(S)   |
|   |              |                  |                                    |  |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT   |              |                  |                                    |  |
| Approved for public release; distribution is unlimited  |              |                  |                                    |  |
| 13. SUPPLEMENTARY NOTES   |              |                  |                                    |  |
| 14. ABSTRACT  |              |                  |                                    |  |
| <p>Personnel costs constitute a major component of the operations budget of the U.S. Navy. Transitioning to a more market oriented staffing model in which Commanding Officers (hereafter labeled the Assignment Officer or AO) are provided incentives to reduce personnel costs that may yield significant savings. An unintended consequence, increased separation rates on the part of sailors, would result in lower levels of readiness for the Navy missions. The essential features of the implemented labor market can be captured in the ultimatum game (UG) in which the proposer (AO) makes an offer and the responder (Sailor) accepts or reject. Since there are multiple billets in a command unit, the billet assignment problem can be modeled as multi-person UG. To investigate the effects of alternative incentives for the AO, we implement the features of the multi-person UG in a laboratory market setting in which an AO is tasked with filling three billets under different institutional rules designed to introduce components of a market based system of staffing billets.</p> |              |                  |                                    |  |
| 15. SUBJECT TERMS   |              |                  |                                    |  |
| Billet Assignment, Ultimatum Game, Manpower and Personnel Costs   |              |                  |                                    |  |
| 16. SECURITY CLASSIFICATION OF:   |              |                  | 17. LIMITATION OF ABSTRACT         | 18. NUMBER OF PAGES                      |
| UNCLASSIFIED  |              |                  | UNLIMITED                          | 78                                       |
| a. REPORT   | b. ABSTRACT  | c. THIS PAGE     |                                    |  |
| UNCLASSIFIED  | UNCLASSIFIED | UNCLASSIFIED     |                                    |  |
|   |              |                  | 19a. NAME OF RESPONSIBLE PERSON    |  |
|   |              |                  | Wendy Douglas                      |  |
|   |              |                  | 19b. TELEPHONE NUMBER              |  |
|   |              |                  | (901)874-2218                      |  |

## Foreword

As part of a research program funded by Capable Manpower Future Naval Capability (FNC), Navy Personnel Research, Studies, and Technology (NPRST) designed a series of laboratory experiments to investigate the benefits of using a labor market approach to assigning Sailors to billets. An experimental laboratory market is used to investigate the effects of different market incentives on the cost of filling billets and on ship readiness. This report explores the net-benefits and tradeoffs of using a more market oriented staffing model to reduce personnel costs.

This effort is supported by Navy Total Force, N15. The point of contact for this effort is Dr. Tanja Blackstone, Navy Personnel Research, Studies, and Technology, (901) 874-4633.

DAVID M. CASHBAUGH  
Director  
Navy Personnel Research, Studies, and Technology

## Summary

Personnel costs constitute a major component of the operations budget of the U.S. Navy. Transitioning to a more market oriented staffing model in which Commanding Officers (hereafter labeled the Assignment Officer or AO) are provided incentives to reduce personnel costs may yield significant savings. An unintended consequence, increased separation rates on the part of Sailors, would result in lower levels of readiness for the Navy missions. The essential features of the implemented labor market can be captured in the ultimatum game (UG) in which the proposer (AO) makes an offer and the responder (Sailor) accepts or rejects. Since there are multiple billets in a command unit, the billet assignment problem can be modeled as multi-person UG. To investigate the effects of alternative incentives for the AO, we implement the features of the multi-person UG in a laboratory market setting in which an AO is tasked with filling three billets under different institutional rules designed to introduce components of a market based system of staffing billets. The laboratory market is used to investigate the effects of different market incentives on the cost of filling billets and on ship readiness (defined as all billets being filled) and group readiness (defined as the fraction of ready ships). We find that there is a tradeoff. As AOs respond to incentives to lower the cost of filling billets there are declines in overall readiness, arising from increased frequency of rejected offers by Sailors. There are unfilled billets and both measures of readiness decline. A range of incentives can be offered to the AO and, as we show, some are superior in both cost savings generated and having a lower negative impact on readiness.

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# Introduction

## 1. Motivation and Objective

Available Navy billets will vary considerably in terms of attractiveness to the Sailor. Although the preference for some characteristics, such as location, will be individual-specific, there are certain billet characteristics that generally, or even universally, determine whether a billet is desirable or not. For example, an absence of promotion potential and training opportunities will render a billet generally bad while the presence of good opportunities for promotion and/or training will make a billet generally **attractive**. **Current billet assignment mechanisms and the nature of “cliff vesting”** provide Sailors that are assigned to unattractive billets little flexibility and the Navy little opportunity to offer inducements or to realize returns from Sailor preferences for attractive billets. The transitioning to a two-sided labor market setting for Sailors will introduce additional options for Sailors and incentives to economize on labor costs to the command unit responsible for filling the billets. A primary motivation for implementing incentives and options on both sides of the labor market is to obtain **reductions in labor costs for meeting the Navy’s readiness requirement**. **This report** presents the results from an investigation of alternative incentive packages that can be offered to the Assignment Officer (AO), and how these incentives affect force readiness and labor costs. Force readiness is generated by filling required billets and the labor costs are the aggregate payments to the Sailors and the commander of the unit.

At the most basic level, an offer by an AO of a billet to a Sailor can be modeled as an Ultimatum Game (UG). In the UG, one agent (here the AO) makes an offer to a second agent (the Sailor). We can model the offer as a share of the amount the AO has budgeted for the billet. The budgeted amount can be set by an agent superior to the AO or by the AO.<sup>1</sup> In terms of the UG, the Sailor can accept the AO offer, in which case the AO and Sailor receive the proposed pay-offs, or the Sailor can reject the offer, in which case, the billet goes unfilled. Rejecting the billet will usually imply that the Sailor has chosen to separate from the Navy (resign) and/or retire.

Several elements make this setting more complex and more interesting when we move it to the Navy task of filling billets on a ship. First, the AO has multiple billets to fill; hence, the AO must present offers to multiple Sailors. Second, billet positions are functionally interdependent; one rejected offer from among multiple offers may substantially reduce the pay-off to the AO. Third, the consequences of the Sailor rejecting the offer have many more potential outcomes than in the standard UG where the proposer and the responder receive the zero pay-off if the responder rejects; in the Navy setting, this may not be the case. The AO may find that the ship fails to meet the readiness requirement (the AO receives a very low pay-off) while the Sailor may find that the outside option (separation from the Navy) pays less (or more) than anticipated.

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<sup>1</sup> The AO is expected to have some control over the allocation of the total personnel budget over billets. In the current setting, billet budgets are administratively set.

To investigate the effects of alternative incentives for the AO, we implement these features of the multi-person UG in a laboratory market setting in which an AO is tasked with filling three billets under different institutional rules designed to introduce components of a market based system of staffing billets. The laboratory market is used to investigate the effects of different market incentives on the cost of filling billets and on ship readiness (defined as whether all billets are filled) and group readiness (defined as the fraction of ready ships). We find that there is a tradeoff. As AOs respond to incentives to lower the cost of filling billets, there are declines in overall readiness. This arises from increased frequency of rejected offers by Sailors with the result that billets are unfilled and both measures of readiness decline. There is a range of incentives that can be offered to the AO. As we show, some are superior in both cost savings generated and having a lower impact on readiness.

We begin with a description of the Billet Assignment Game as we are calling the task facing the Navy. To investigate the properties of the Game, we construct a laboratory market setting and collect data from participant decisions in this experiment setting.<sup>2</sup> The structure of the experiment and the data analysis are presented in subsequent sections.

## 2. Properties of the Billet Assignment Game

We begin here with a brief discussion of the billet assignment game as implemented in the lab. The actual implementation is described in more detail in the following section.

- There are  $N$  command units (groups), command units are denoted by  $n$  and  $n \in \{1, \dots, N\}$ .
- For each of the  $N$  command units, there is 1 Assignment Officer, denoted  $AO_n$
- The ratio of available Sailors to Assignment Officers is 3:1. Sailors are denoted as  $s$  and  $s \in \{1, \dots, 3N\}$ .
- For each command unit, there are 3 billets (jobs) of different rank that can be filled by Sailors. The billet rankings are **Red**, **Blue** and **Green** denoted as  $b \in \{R, B, G\}$ .
- For **each of the command unit's 3 billets, there are 3 accounts corresponding to the billet ranking**. The individual value of these accounts is denoted as  $p_{nb}$ .

---

<sup>2</sup> Laboratory markets have been widely used to investigate policy effects (Plott, 1987; Alm, Jackson, and McKee, 2009). Lab markets provide a controlled setting in which to explore the behavioral effects of proposed policy options at a low cost.

- Each ship is given a total budget,  $P_n$  that is split between the *Red*, *Blue* and *Green* billet accounts. It is necessary that  $p_{nR} + p_{nB} + p_{nG} = P_n$ . It is also necessary that  $p_{nR} \geq p_{nB} \geq p_{nG}$  denoting the relative importance of the individual billets in contributing to readiness.
- The Assignment Officer chooses how much from each of the 3 billet accounts to offer a Sailor in an attempt to fill the billet. The individual offers are denoted  $o_{nb}$  and  $o_{nR} + o_{nB} + o_{nG} = O_n \leq P_n$ .
- Each period, a Sailor is assigned to a single billet on a single command unit and can either accept their offer from the AO or reject that offer and take their outside option, denoted as  $l_{nb}$ .
- The AO can face 2 conditions regarding the requirement to fill billets. In the first, **all billets are deemed critical and the ship is deemed “not ready” if any billet is unfilled. In the second, no billets are deemed critical and the ship is “ready” if any billets are filled.**
- **If a Sailor rejects the offer, the ship may be deemed “not ready” if all billets are critical.** The Sailors who accept are assigned to the billet accepted at the offered wage.
- **Ships are members of a battle group. The group is deemed “not ready” if less than stated fraction of the ships is not ready.**

### 3. Experiment Environment

In the discussion that follows, we utilize a representative command unit consisting of an Assignment Officer (AO) and three Sailors. In general, we use the terms Red, Blue and Green to denote the hierarchy of attractiveness of the three billets (Red being the most desirable billet as well as the most valuable to the Navy, then Blue, then Green). There are interaction effects between the requirement that unattractive billets must be filled (readiness) and the objective of utilizing incentives at the AO level to reduce labor costs to the Navy. In an experiment session, there can be up to five command units (groups), each with one AO and three Sailors. The sessions run for a number of rounds and Sailors are regrouped and assigned to a new AO each period. The roles assigned to a participant, i.e., AO or Sailor, are maintained throughout the session to be consistent with the field setting.

#### 3.1 An ultimatum game framework

As we discussed earlier, the interaction between an AO and an individual Sailor can be characterized as an UG. The AO has a budget (the “**stake**” in the classic UG) and

takes the role of the proposer while the Sailor is the responder. In addition, as we argued, a simple variant of this UG can be used to implement the assignment game facing a ship captain and a set of Sailors being offered billets. In this variant, a single proposer (AO) makes offers to a set of responders (Sailors) each of whom can accept or reject. The readiness requirement can be imposed through requiring that some specified (could be all) billets be filled with a penalty imposed on an AO that fails to meet this requirement. Thus, we are setting up a job assignment game in which the Navy or the AO assigns billets and the Sailor can accept or reject the assignment. Both sides bear consequences of this rejection. The Navy has problems meeting readiness requirements while the Sailor(s) alters his/her or their career path(s).

Heterogeneous assignments can have an effect on the individual Sailor decision to accept the assignment or separate. Expanding the simple, UG to include four players, i.e., the proposer (AO) and three responders (Sailors), allows us to introduce heterogeneity across the billets, alternative means for compensating the proposer (AO), and heterogeneity across the Sailors. The source of the heterogeneity across the Sailors can be endogenous (ability) or exogenous (assigned).

A second extension to the classic UG allows us to introduce (asymmetric) costs of the responder rejecting the offer. There is a cost to both the Navy and the Sailor of early separation. Depending on the skills of the Sailor, the disagreement cost may be greater for the Navy or for the Sailor. For example, if the Sailor possesses skills valued in the civilian workplace, the costs of early separation (rejecting the assignment) may be very low.

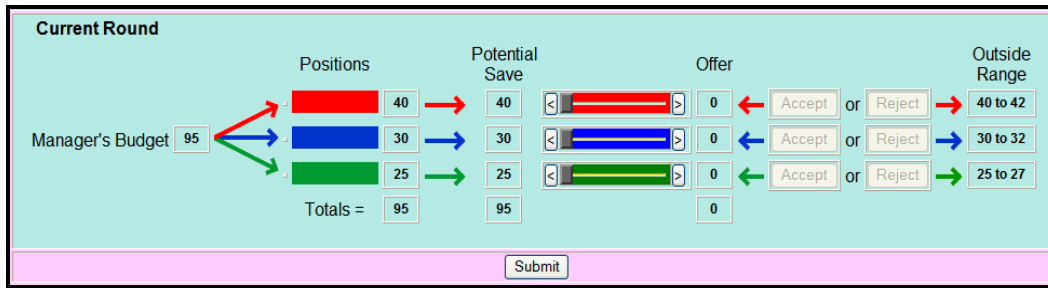
A third extension is to introduce uncertainty regarding the pay-offs to both the proposer and responders. A fourth extension is to introduce either informational asymmetries in which it is the Navy that is better informed or the Sailor.

To **illustrate the basic elements of the game, an example of an AO's decision screen is** shown in Figure 1. To avoid any confusion, the positions in the experimental setting are described as Manager (for the AO) and Worker (for the Sailor). In the Figure, the total budget for this command unit is  $P = 95$ .<sup>3</sup> The billet account values are predetermined (in this example) by the Navy for the Red, Blue and Green billets and are 40, 30 and 25, respectively. Note that  $p_R + p_B + p_G = P$ . Here the AO must offer each Sailor an amount from the respective billet account. Each Sailor can accept or reject that offered amount. Rejecting an assignment in this setting implies that the Sailor separates from the Navy (resigns or retires) and earns his or her outside option value ( $l_b$ ). For example, if a Sailor rejects an offer for the Red billet, that Sailor earns their outside option value  $l_R \in (20, 21, 22)$ .<sup>4</sup>

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<sup>3</sup> Throughout, the subscripts for the command units,  $n$ , are dropped.

<sup>4</sup> In this particular example, there is uncertainty about the actual value of the outside option. These outside options are for illustration only. In practice, we set the mean lower and the degree of uncertainty is typically higher to reflect the uncertainty associated with separation from the Navy.



**Figure 1. AO's decision set with heterogeneous Sailors and Exogenous billet budget**

This setting imposes a fairly stringent set of conditions for the assignment game. Since there is a one-to-one match between available Sailors and billets, a rejection by a Sailor implies that the billet cannot be filled in the current period.

### 3.2 Discussion of treatments

From the discussion of the extensions to the basic UG, it follows that there are several experimental treatments that could be examined here. These can focus on factors affecting the behavior of the AO, as in Table 1, or factors affecting the behavior of the Sailor, as in Table 2.

**Table 1**  
**AO Treatment Properties**

|   | <b>Readiness Requirement:<br/>All Positions Critical</b> |  |
|---|--|--|
|   | <b>Position Budget<br/>Values Exogenous</b>              | <b>Position Budget<br/>Values Endogenous</b> |
| <b>AO Compensation</b>                  |  |  |
| Fixed Payment                           | 1<br>(Baseline)  | 5  |
| Share Save Bonus                        | 2  | 6  |
| Tournament Bonus                        | 3  | 7  |
| Combined Share and Tournament Bonus     | 4  | 8  |
| Group Ready Bonus with Tournament Bonus | N/A  | 9  |

As previously noted, a primary motivation for implementing a market for Sailor assignments is to obtain reductions in labor costs for meeting the Navy's readiness

requirement. The market components we investigate are the effects of performance incentives offered to the AO to reduce labor costs and the effects these have on force readiness and labor costs. Currently, the Navy offers no incentive to the AO to spend less than the budget allocated to fill the billets on the ship and the amounts allocated for each billet are administratively determined. In practice, under the present system, the Navy manpower and personnel (M&P) budget is set by Congress. That funding line is then pushed down to the Navy to allocate as necessary to meet mission requirements. Readiness levels are set by mission type (war vice peace operations). Once the mission/readiness combination is established, the required skills and number of bodies are determined by ship/department. The AO has no say in budget allocation, must meet minimum readiness as mandated by mission type<sup>5</sup> and Sailor/skill allocation is determined by Navy conditional on mission. The AO has little say over the mission and essentially accepts the labor that is allocated to him. Spending less than the budgeted **amount (underutilizing offered labor) is effectively penalized by reducing the AO's budget for the following budget cycle.**

Table 1 is organized to group categories for investigation. In our Baseline (Treatment 1), we preset the billet sizes so that the AO is unable to allocate the budget and only able to make offers to prospective Sailors. This simulates the current setting so the AO has no discretion over the allocation of the budget over billets. In Treatment 1, the AO has no incentive to spend less than the budget allocated to fill the billets. We introduce a market element here as we allow the AO to determine the offers to the Sailors to fill the billets. Within this setting, we investigate a range of possible incentive packages that could be offered to the AO as part of a market setting. We parallel the Treatment 1 setting in Treatment 5 but we allow the AO to first allocate the labor budget across the billets and then to make the Sailors offers from the budget.

A study of Table 1 suggests that a great many treatments are needed for this investigation. To conserve the subject pool and meet the budget, we elected to pursue treatments that covered salient features of the decision setting. Within this setting, we investigated broad categories of AO compensation – winner-take-all tournaments and the assignment of a share of the realized savings to the AO. To capture the joint requirement of reducing costs and meeting readiness requirements, we introduced **alternate readiness requirements as a treatment. We implemented the “all positions critical” setting by imposing a zero pay-off to the AO if *any* position is unfilled (i.e., a Sailor rejects the offer made).**

We introduced incentives to reduce labor costs through offering the AO a share of the wage budget that is saved (Treatments 2 and 6). Many share values are possible, of course, but we implemented a constant 25% share. Rank order tournaments are frequently proposed as a means of providing incentives for workers and managers. The pay-offs in such tournaments may take the form of a cash bonus, a promotion, or some non-cash prize (say an “all expenses paid vacation”). In the experimental setting, all values are induced (Smith, 1975) and this required that all pay-offs be monetized. Thus, the tournament pay-offs (Treatments 3 and 7) are in the form of money added to the

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<sup>5</sup> However, can exceed minimum readiness through overstaffing or assignment of over qualified Sailors. These actions, of course, increase costs to the Navy.

**AO's base pay. The winner of the tournament is the AO filling the three billets at the lowest cost.** Since behavior in tournaments has been shown to depend on the magnitude of the bonus, we implemented three bonus levels (different sessions). **The smallest bonus setting pays out approximately 20% of the AO's base pay as a bonus.** With five AOs competing, the expected pay-off from the small tournament is only about **5% of the AO's base pay.** **The medium tournament pays out a bit over 100% of the AO's base pay** and with five AOs competing, the expected value is about 20% making this comparable to the share of savings bonus of Treatments 2 and 6.

Participating in tournaments can impose risk on the players especially if losing implies a negative pay-off. In the billet assignment setting, the AO will earn zero payment for the round if any Sailor rejects and the probability of a rejection is likely increasing in the amount the AO attempts to save in order to enhance the chance of winning the tournament. To offset this risk, we coupled a share of saving bonus with a (reduced) tournament bonus in Treatments 4 and 8. The joint bonus was set such that the expected value of winning the tournament plus the share of savings bonus was equivalent to the medium tournament pay-off.

Finally, there is a group level effect that must be considered by the Navy. If one or more ships in a group are deemed to not meet readiness requirements, the entire group has a lower level of effectiveness for the mission. Thus, an AO aggressively competing to win the tournament and, thereby, increasing the probability of rejection of an offer may impose an externality on the other AOs in the group. One solution is to introduce a reward (or penalty) that captures this effect. We constructed the reward as if the AOs are playing the minimum contributing set (MCS) - public good game.<sup>6</sup> Thus, if the group meets the readiness requirement, as defined, all AOs receive a bonus pay-off. The AO with the lowest cost for successfully filling the billets receives the tournament bonus as well. If the group readiness requirement is not met, the AOs do not receive the group readiness bonus and the AO successfully filling the billets at the lowest cost does NOT receive the tournament bonus.

Complicating the objective of reducing labor costs is the requirement that the Navy fill billets of obviously differing qualities and comparisons by Sailors are inevitable. Such comparisons can potentially lead to increased rates of rejections by those offered less desirable billets. In the experiment setting, less desirable billets are implemented as billets labeled Green and these have lower values to the Navy and, hence, lower pay rates. Heterogeneity across billets can be partially offset through compensating wages (hedonic wages) and/or the potential of future superior assignments. In the simple UG, there is a fixed pot that is to be divided by the proposer. The analog in our assignment game is that there is a surplus value or total pay-off to filling a billet. The offer from the Navy constitutes a sharing of this surplus. With multiple billets, it is inevitable that Sailors will be assigned to billets of differing values. To the extent that Sailors assigned to less desirable billets are aware of this, previous research (Ponsko, 2007) has shown that rejections are more likely in the case of responders (Sailors) being assigned to the less desirable (smaller value) billet. To some extent, this higher rejection effect can be offset by offering a larger share of the pot to the responder assigned to the small pot.

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<sup>6</sup> Van de Kragt et al. 1993; Dawes, et al, 1986; Erev and Rapoport 1990; Cooper and Stockman 2002.

For the Navy, this larger share can take many forms. A second objective of our investigations is toward understanding the means of reducing the costly rejections of those assigned to the less desirable billet. Since comparisons by Sailors require knowledge of offers made to others, we investigated the effect of such knowledge by varying the information provided to Sailors concerning the offers made to other Sailors within a unit.<sup>7</sup>

This may be a particularly relevant factor if changes occur to the cliff-vesting pension system. In effect, by removing cliff-vesting, the result is higher values on the options for the Sailors outside the Navy. Full exploration of this topic is beyond the scope of the present project. Our game setting could be modified to deal with this through linking period decisions and providing a capital asset (pension) based on number of rounds in Navy. Intuition suggests that the frequency of rejection will be very low in the final years under a cliff-vesting system even when such offers might well have been rejected **earlier in the Sailor's career**. However, the overall effect is an empirical question and worthy of further investigation.

The Sailor always has a non-zero pay-off outside option in our implementation of the **UG**. While we can label this as “outside option” as it would pertain to the Sailor choosing to separate from the Navy, this option may also be thought of as a competing offer from another AO to fill a similar billet on another ship. Since we allow Sailors to reject in one round and to sign in the next, either we are effectively implementing the outside option as an offer from another AO **or** we are implementing a non-cliff-vesting setting in which Sailors may choose to separate and to rejoin at their current classification.

As shown in Table 2, the treatments can be organized into some broad categories: assignment rules, information available, decision timing, and relative costs of disagreements (separation from the Navy). The first two rows reflect the alternative mechanism for assigning the budget of the AO and for assigning Sailors to billet classes (ranks or position importance). Sailors can be assigned to a low valued billet based on own performance or by a process that could be characterized as random.<sup>8</sup> Further, the AO may be able to set the amount of budget to allocate to the billets or the allocation may be based on rules.

A second class of treatment concerns the extent and symmetry of information regarding the outside options facing the Sailors. In the field, the relative pay-off to the billets may or may not be common knowledge (known to all players in the game). We can refine this information setting to include the possibility that uncertainty regarding the pay-off to the billets will introduce informational differences as some parties may

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<sup>7</sup> A question for further research is whether varying pays affect stay/leave decisions and next period offers/acceptances. There is a perception that varying pay offers (for example by merit or skill/education) would adversely affect retention rates.

<sup>8</sup> Assigning Sailors to billets based on their own performance is achieved through a simple number sorting game. Before the start of each round, each Sailor is randomly grouped with two other Sailors. Each Sailor tries to sort a mixed arrangement of numbers in order as fast as he or she can. The fastest to complete the sorting task is assigned to the Red billet and the slowest to the Green billet within the group of three Sailors assigned to an AO.



have superior information (less diffuse priors in the Bayesian sense). The number of Responders (Sailors) will also affect the level of information. With three Sailors offered billets, each knows more about the distribution of available assignments than if only two are offered billets at a given time. The results of experiments with these differing information regimes will inform us of the effects of alternative information settings that could be applied to this assignment game.

**Table 2**  
**Sailor Treatment Properties**

| Number | Treatment Condition   | Treatment Values                   |
|--------|---|------------------------------------|
| 1      | Billet Assignment Mechanism for Sailor                      | Skill Test*<br>Imposed Randomly    |
| 2      | Billet Budget Assignment Mechanism for AO                   | AO Choice*<br>Administrative Rule* |
| 3      | Information Concerning Outside Option Values for Sailor     | Common*<br>Private*                |
| 4      | Pay-offs to Proposer and Responder                          | Certain*<br>Uncertain*             |
| 5      | Repeated Game   | Yes<br>No*                         |
| 6      | Number of Rounds  | Known<br>Unknown*                  |
| 7      | Rejection Costs   | Symmetric*<br>Asymmetric*          |
| 8      | Range of billet values between Red (top) and Green (bottom) | Large*<br>Small                    |

\*Implemented and investigated.

Repeated interactions offer additional learning (information) opportunities but also additional opportunities for compensation for assignment to the less desirable billet. The assignment game can be structured as a series of independent assignments (one shot game) or as a chain in which the set of possible future assignments is dependent on the current assignment. For the same reason, the end period may be known with certainty or only inferred. Under the current market configuration (or rules), a Sailor could potentially make conditional offers to accept assignments. This would allow a **Sailor to “buy” a superior billet (to gain the training advantage, for example) by offering** to accept a smaller share of the budget allocated to the billet.

Rejections of assignments are costly to both the Navy and the Sailor. For the Sailor, the rejection costs reflect foregone earning opportunities if he or she remains in the

Navy, the reduction in future retirement pay, the loss of potential future training, and the impact of these lost opportunities on potential civilian earnings. For the Navy, the rejection costs reflect the loss of the Sailor and the embodied human capital as well as potential failures to achieve readiness. Thus, a key setting is reported in line 7 of Table 2.

As with the exit timing problem discussed in Table 1, the range of possible treatments reported in Table 2 implies that one could conduct many treatments to fully investigate all aspects of this assignment game. Again, the central tenet of experimental design is that treatments must be varied orthogonally and, given the number of elements that could be varied as per the table, a complete experimental design would involve dozens of different treatments. Careful choice of treatments allows a simpler design and enables the investigation to be conducted with fewer sessions. Thus, for the present project we have elected to focus on a subset of settings indicated by the entries marked by an asterisk in Table 2. We elected to conduct sessions in which the number of rounds is unknown to the subjects; current manpower policy in the Navy allows for flexible separation dates. Similarly, we elected to concentrate on the setting in which the billets are assigned based on performance (merit).<sup>9</sup>

The UG setting provides data on the decisions of both the proposer and the responders in each game. Our setting is a single shot game (proposer/responders are reassigned each period) and we obtain a series of individual-level decisions that yields a panel dataset. The decision metrics we collect from these decisions are the allocations offered by the proposer (a more or less continuous variable) and the accept/reject decision of the responder (a binary variable). Thus, the econometric analysis will be designed to address the difference in the measurement of behavior.<sup>10</sup>

We can learn some important lessons from conducting a set of experiments in this setting. Given that the Navy will always be required to fill some billets having undesirable characteristics, can mechanisms be designed to reduce the costs of filling billets while limiting the frequency of rejected assignments? The experimental investigations allow us to test alternative mechanisms in a low cost manner. We are concerned with relative behavior across the alternative mechanisms and the lab provides the controls necessary for us to infer that differences in observed behavior are due to treatments imposed by the experimental design rather than potential confounding effects.

Since each group (1 AO and 3 Sailors) in a session represents a ship, we can evaluate the data at different levels. Each ship has an individual readiness requirement denoted by the billets that must be filled if the AO is to receive compensation. Further, a session consists of 4 or 5 ships (16 or 20 participants in the session) thus we can define the session as a Battle Group and the fraction of ships meeting individual readiness defines the BG readiness. In the baseline, setting the AO has a disincentive to save any of the payroll budget since the usual management office response would be to reduce the

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<sup>9</sup> Although many enlisted, personnel undoubtedly feel that assignments are random - this is generally untrue.

<sup>10</sup> That is, the responder (Sailor) data will be analyzed using a probit structure while the proposer (AO) data will be analyzed using a continuous dependent variable approach.

budget available in the next period. Thus meeting readiness is the only element on the AO pay-off function. In the alternative management settings, the AO does have an incentive to save on total payroll while still meeting readiness. While saving on the payroll may not lead to increased rejections of offers by Sailors (loss of readiness) this is an empirical question to be investigated. Our data will allow us to better understand the tradeoffs associated between savings and readiness across the alternative incentives mechanisms.

For the treatments reported in Table 1, all positions are deemed critical and the AO is not paid unless all three billets are filled. We focused attention on the settings in which all positions are critical to reflect the relative importance of fleet readiness. To explore **the effects of relaxing the readiness requirement, we implement a “no position critical”** setting by paying the AO for each position filled. The billet values to the Navy reflect the compensation paid the AO per billet filled. That is, the Red position pays the most and the Green position pays the least. The treatments implemented under this weaker readiness requirement are congruent with Treatments 1, 2 and 4, in Table 1.

## 4. Experiment Results Discussion

### a) Aggregate results

Thirty-two sessions have been completed for the purposes of the project. Several pilot sessions were conducted to inform the selection of parameters and to conduct debriefing sessions with the subjects in order to refine the experimental instructions. These data are not included in the current analysis since the settings are not exactly what the subjects in the actual sessions experienced. In all, we collected data on decisions made by 149 subjects in the AO role and 447 subjects in the Sailor role. For the purposes of analysis here, we restrict our attention to the subset of the data covered **by treatments listed in Table 1 and the three treatments with the “no positions critical”** setting. Thus, we have a panel datasets consisting of 126 subjects in the AO role and 378 in the Sailor role. Sessions lasted a total of 20 rounds and the overall dataset has 10,080 observations in a panel dataset.

The summary results for the implemented sessions are reported in Table 3. In all sessions, the Sailors completed the sorting task, which determined the billet they were assigned to (Red, Blue or Green). In the **baseline**, setting the AO has an incentive to exhaust the budget since there is no pay-off to saving and, in fact, there is a penalty to saving reflecting the incremental budgeting rules currently in effect.<sup>11</sup> In Table 3, we report several metrics. Column (1) denoted reports the offered amounts by the AOs while column (2) reports the amounts actually paid. The difference is because Sailors may reject offers. Column (3) reports the percentage of ships deemed ready under the condition that all billets are critical. Column (4) reports the group level readiness. We

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<sup>11</sup> **This raises an interesting point for future research. From Navy’s point of view** – readiness costs – so what other policies besides incentives can be adopted to reduce costs for a given level of readiness? Reduce the number of rotations? Is the readiness level (95% in most ships at peace time) set too high (inefficient level)?

define the group to be deemed ready if more than 75% of the ships are ready. (Other criteria could be analyzed.) Finally, column (5) reports the average cost of filling all three billets.

In the “incentive” settings, the AO is rewarded for reducing the costs of filling the billets. The reward was implemented in various ways. The AO receives a share of the saving from the budget (called *share of savings*) in one setting. Thus, the Navy obtains the residual share of the cost savings after it pays out the bonus to the AO. Since we set the share of saving paid to the AO at 25%, the potential cost reduction for the Navy is quite large. In an alternate incentive setting, we introduce a rank order tournament; AOs compete to win a prize. The prize is awarded to the AO that successfully fills the required billets at the lowest cost relative to the other AOs (called *tournament bonus*). We elected to combine the tournament bonus with the share of savings (denoted *share of saving plus tournament bonus*) to provide a greater incentive for risk-averse decision makers to save since the tournament alone imposes a rather sharp incentive (zero pay-off versus the bonus). Finally, recognizing that an AO failing to achieve readiness imposes a cost on the group, we implemented a treatment that incorporates the public good element – all the AOs receive a bonus if the group meets the aggregate readiness target. While the share of the savings was held constant (25%) over all sessions implementing this incentive structure, the amount of the tournament bonus varied. As displayed in Table 3, three sessions used a small bonus amount (10 or 20), two sessions used a medium bonus (40 or 50), and two sessions used a large bonus (100). In aggregate, the results in Table 3 demonstrate that the AOs respond to the incentives by lowering the amount of their offers to Sailors, thus, saving on personnel costs.

However, there is a tradeoff. While the incentive types summarized in Table 3 are capable of generating a reduction in personnel costs, they also reduce the level of readiness at the ship and group level. Before we discuss this in detail, it is worth noting that introducing a tournament incentive with a big bonus pay-off does not reduce costs relative to the baseline. The average cost is 144.43 in the baseline setting and 144.96 in the big tournament setting. There is a substantial reduction in both ship and group readiness.

It is interesting that AOs offer less than 100% of their budgets in the baseline despite their being no motive to do so. Total wage offerings in the incentive treatments are generally in the range of 25% lower than in the baseline treatment. While all of the incentive mechanisms lead to a fall in ship and group readiness, the Medium Tournament and the Share of Savings treatments fare well overall in this comparison. The cost reduction is approximately 20 (significant at  $p < 0.00$ ) with the Share of Savings performing slightly better (not statistically significant) in the readiness metric.

We see a significant reduction in readiness for each incentive structure relative to the baseline ( $p < 0.00$  for each pair-wise test comparing the unconditional percentages). Our prior expectation was that the blend of Share of Savings and tournament bonus would perform best since the share of savings would mitigate the risk inherent in a rank order tournament. In contrast, we find this to undoubtedly be the worst performing incentive mechanism. This incentive package results in a 27% reduction in readiness relative to the baseline and an insignificant level of savings compared to the baseline

when the billets are filled (144.43 vs. 140.30). We suspect that the added complexity of the dual-incentives overwhelms the potential risk spreading.

On average, the small and medium tournaments perform roughly the same as the share of savings, with similar reductions in payroll costs and similar reductions in readiness. These incentive packages clearly lead to reductions in the costs of filling the billets but at the cost of ship readiness. It is clear from our aggregate results that achieving higher levels of readiness imposes a cost for the Navy in terms of higher offers to Sailors to reduce the frequency of rejection. An especially intriguing result observed here is the poor performance of the large bonus incentive structure. While the increase in the cost of filling the positions is unsurprising given a large bonus, we observe a low readiness measure relative to both the baseline and the other tournaments and the share of savings incentive. We return to the discussion of the trade-off between cost savings and readiness later in this report.

**Table 3**  
**Summary Statistics by Incentive Mechanism**

| Treatment Conditions                      | Session Numbers from Dataset | Average amount offered by AO (% of budget) | Average amount paid by AO (% of budget) | Readiness by Ship % of Ships | Readiness by Battle Group | Average cost of filling all billets |
|---|------------------------------|--|---|------------------------------|---------------------------|-------------------------------------|
|   |                              | (1)  | (2)                                     | (3)                          | (4)                       | (5)                                 |
| Baseline                                  | 1,15,22,11,3,17              | 86.53<br>(0.81)<br>[540]                   | 82.57<br>(0.99)<br>[540]                | 81.85<br>(1.66)<br>[540]     | 88.33<br>(2.94)<br>[120]  | 144.43<br>(0.77)<br>[442]           |
| Share of Savings                          | 2,16,20,4,18                 | 60.46<br>(0.37)<br>[460]                   | 55.10<br>(0.69)<br>[460]                | 74.35<br>(2.04)<br>[460]     | 74.00<br>(4.41)<br>[100]  | 123.80<br>(0.33)<br>[342]           |
| Tournament Bonus (Small) plus Public Good | 25,26,27,28                  | 62.59<br>(0.81)<br>[400]                   | 56.88<br>(1.06)<br>[400]                | 70.25<br>(2.29)<br>[400]     | 48.75<br>(5.62)<br>[80]   | 123.36<br>(1.07)<br>[281]           |
| Tournament Bonus- very small              | 14                           | 67.18<br>(1.43)<br>[100]                   | 59.12<br>(2.20)<br>[100]                | 65.00<br>(4.79)<br>[100]     | 35.00<br>(10.94)<br>[20]  | 125.85<br>(1.99)<br>[65]            |
| Tournament Bonus- small                   | 12,21                        | 55.97<br>(0.72)<br>[180]                   | 50.54<br>(1.11)<br>[180]                | 68.89<br>(3.46)<br>[180]     | 55.00<br>(7.97)<br>[40]   | 115.73<br>(0.83)<br>[124]           |
| Tournament Bonus- medium                  | 5,6                          | 59.54<br>(0.51)<br>[180]                   | 53.59<br>(1.13)<br>[180]                | 73.89<br>(3.28)<br>[180]     | 67.50<br>(7.50)<br>[40]   | 125.54<br>(1.62)<br>[133]           |
| Tournament Bonus- big                     | 13,32                        | 61.04<br>(0.83)<br>[200]                   | 54.10<br>(1.32)<br>[200]                | 66.50<br>(3.34)<br>[200]     | 35.00<br>(7.64)<br>[40]   | 144.96<br>(3.58)<br>[133]           |
| Share of savings plus Tournament Bonus    | 7,8,9,10,19                  | 56.96<br>(0.28)<br>[460]                   | 48.53<br>(0.74)<br>[460]                | 61.09<br>(2.28)<br>[460]     | 51.00<br>(5.02)<br>[100]  | 140.30<br>(1.71)<br>[281]           |

Note.

Standard errors are in parentheses and the number of observations is in brackets.

Calculating the total cost to Navy of filling all billets:

(1) *Baseline*

Total amount paid to AO when all positions were filled = 45

(2) *Share of savings*

Total amount paid to AO when all positions were filled = 45 + share of savings to AO

(3) *Tournament*

Total amount paid to AO when all positions were filled = 45 + tournament winnings

(4) *Tournament + share of savings*

Total amount paid to AO when all positions were filled = 45 + tournament winnings + share of savings

(5) *Tournament + group bonus*

Total amount paid to AO when all positions filled and Group readiness requirement met = 45 + tournament winnings + group readiness bonus

## b) Econometric Modeling

The descriptive statistics reported and discussed above are useful, but conditional responses estimated via econometric modeling yield additional insights. The estimation results for the AO behavior are reported in Table 4 and for the Sailors in Table 5.<sup>12</sup>

For the AOs, we estimate results for three metrics. The first is the ***Cost of Filling all Positions*** which is the sum of the payments to Sailors accepting the AO offer and the payment to the AO (includes any incentive package in place). The second is ***Ship Readiness***, which is a binary variable equaling one if all billets on a ship are filled and zero otherwise. The third is the ***Group Readiness***, which is defined as 75% or more of the ships in the group being ready.

A number of variables are predicted to affect these metrics. ***Limited Information*** is a dummy variable equaling one if both the Sailors and AOs are uninformed of the outside options. When the information is available, it is fuzzy, through the use of the uniform distribution discussed above, the uncertainty being symmetric to the Sailor and the AO. Absent complete information regarding the value of outside options, the Sailors may be more likely to accept the offers made by the AOs and, to the extent, the AOs exploit this, the aggregate wage offers can be lowered.<sup>13</sup> ***Pay per Position*** is a dummy variable equaling one if the AO basic compensation is positive when any billet (Red, Blue, or Green) is filled. This represents a weaker readiness condition – the AO is compensated even when one or more billets are unfilled. ***Tournament-Combined*** is equal to one if any form of the tournament treatment is in effect. Thus, this variable is equal one if the small, medium or large tournament is in effect. In most of the sessions, the distribution of the budget across the billets is set by administrative fiat but to investigate the potential effect of allowing the AO to set the allocation we conduct sessions in which the AO first allocates the budget and then makes the offers to the Sailors. We denote this with a dummy variable ***AO determines budget per position***. The ***Share of Savings*** is

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<sup>12</sup> For the regression analysis, we use the data from the sessions listed in Table 3 plus the sessions in which the AO sets the billet sizes and the sessions in which the AO faces the “no positions critical” setting (15 sessions in total). This yields 126 panels for AOs and 378 for Sailors.

<sup>13</sup> This is a complex issue. The Navy has several websites that provide information on outside employment opportunities. It would seem that the Navy is harming itself through such actions. On the other hand, the AO needs such information when making offers. Further, Sailors may be using this information to decide on training options while in the Navy and such information may improve retention and also availability of Sailors for demanding billets.

equal to one if the treatment incorporates a bonus to the AO based on the savings realized from the filled billets. All bonus variables are set at zero if any billet is unfilled – the bonus is conditional on meeting the readiness requirement. To investigate the effects of the different size tournaments we create dummy variables, *Tournament-large*, *Tournament-medium*, *Tournament-small* and *Tournament-very small*. When these variables are included, we drop the overall tournament dummy. We conduct a session using staff personnel from the university and denote this by dummy variable *Non-student participants*. Finally, the variable *Share of savings plus tournament bonus* is equal to one when this combined incentive structure is offered to the AO.

**Table 4**  
**AO Responses to Incentives**

| Independent Variables                         | Cost of Filling All Positions | Cost of Filling All Positions | Ship Ready (binary) <sup>†</sup> | Ship Ready (binary) <sup>†</sup> | Group Ready (binary) <sup>†</sup> | Group Ready (binary) <sup>†</sup> |
|---|-------------------------------|-------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|
| <i>constant (baseline)</i>                    | 143.71***<br>(3.76)           | 145.97***<br>(4.05)           | 1.13***<br>(0.18)                | 1.12***<br>(0.18)                | 1.81***<br>(0.184)                | 1.74***<br>(0.19)                 |
| <i>Share of savings</i>                       | -18.00***<br>(3.93)           | -18.03***<br>(4.36)           | -0.38**<br>(0.16)                | -0.38**<br>(0.16)                | -1.04***<br>(0.148)               | -1.04***<br>(0.16)                |
| <i>Share of savings plus tournament bonus</i> | 1.94<br>(4.07)                | 0.55<br>(4.48)                | -0.77***<br>(0.16)               | -0.76***<br>(0.16)               | -1.77***<br>(0.151)               | -1.75***<br>(0.159)               |
| <i>Tournament – combined</i>                  | ---                           | -14.82***<br>(4.22)           | ---                              | -0.59***<br>(0.15)               | ---                               | -1.58***<br>(0.148)               |
| <i>Tournament plus public good</i>            | -20.68***<br>(4.50)           | -23.01***<br>(4.94)           | -0.52***<br>(0.18)               | -0.51***<br>(0.17)               | -1.46***<br>(0.182)               | -1.54***<br>(0.188)               |
| <i>Tournament-very small</i>                  | -18.22***<br>(6.84)           | ---                           | -0.71***<br>(0.26)               | ---                              | -1.95***<br>(0.218)               | ---                               |
| <i>Tournament-small</i>                       | -29.09***<br>(5.57)           | ---                           | -0.58***<br>(0.22)               | ---                              | -1.390***<br>(0.182)              | ---                               |
| <i>Tournament-medium</i>                      | -16.75***<br>(5.39)           | ---                           | -0.49**<br>(0.21)                | ---                              | -1.23***<br>(0.183)               | ---                               |



|  |                    |                     |                    |                  |                     |                     |
|--|--------------------|---------------------|--------------------|------------------|---------------------|---------------------|
| <i>Tournament-large</i>                  | 4.30<br>(5.39)     | ---                 | -0.64***<br>(0.21) | ---              | -1.96***<br>(0.181) | ---                 |
| <i>Limited information</i>               | 0.99<br>(3.83)     | -1.41<br>(4.06)     | 0.09<br>(0.15)     | 0.12<br>(0.14)   | 0.40***<br>(0.122)  | 0.55***<br>(0.125)  |
| <i>Pay per position</i>                  | -10.25**<br>(4.12) | -12.07***<br>(4.54) | -0.27*<br>(0.15)   | -0.25*<br>(0.15) | 0.95***<br>(0.151)  | 1.02***<br>(0.162)  |
| <i>AO determines budget per position</i> | 5.12<br>(4.62)     | -2.52<br>(4.65)     | 0.05<br>(0.18)     | 0.06<br>(0.16)   | -0.12<br>(0.146)    | 0.034<br>(0.141)    |
| <i>Non-student participants</i>          | 4.90<br>(6.81)     | 2.59<br>(7.52)      | -0.42<br>(0.26)    | -0.41<br>(0.26)  | -1.25***<br>(0.218) | -1.18***<br>(0.233) |
| <i>observations</i>                      | 1801               | 1801                | 2520               | 2520             | 2520                | 2520                |
| <i>LR</i>                                | 77.37              | 52.02               | 57.06              | 56.19            | 373.46              | 336.69              |

Note.

Standard errors are in parentheses. \*, \*\*, \*\*\* denote 0.10, 0.05, and 0.01 significance levels, respectively.

\*estimated using maximum likelihood with round-level fixed effects and subject-specific random effects (126 unique subjects)

In general, incentive packages decrease the cost of filling billets. The coefficients on the dummy variables representing the incentive packages are generally negative, indicating lower costs than in the baseline treatment, in the equations estimating the cost of filling billets. It is interesting to decompose some of the effects, though. The coefficient on Tournament-combined is negative and significant. However, this effect is not uniform and when we decompose the tournament effect an interesting result emerges. The coefficients for the small and medium (pay-off) tournaments are negative and significant as is the coefficient on the dummy variable representing a bonus based on the share of savings realized. However, as the results in Table 4 show, a large tournament does not reduce costs relative to the baseline and this is also the case for the combined incentive package consisting of the share plus a tournament (with the medium prize). Allowing the AO to set the amount of the budget allocated to the individual billets does not affect costs. The coefficient on AO determines budget per position is not significant. As expected, when the AO has information regarding outside options available to the Sailors, the allocated budget simply reflects these values.

Comparisons of the coefficients from the regression results in the first column of Table 4 indicate that the share of savings incentive results in equivalent reductions in the costs of filling billets compared to the very small and medium tournaments and the tournament with a group bonus. The small tournament setting resulted in significant cost savings relative to the baseline, the other tournament settings and the share of savings ( $p = 0.045$ ). In short, the small tournament performed best in terms of reducing the cost to the Navy of filling all three billets.

The objective of the AO incentives is the reduction in costs but readiness conditions must also be met and this requires that the billets be filled – that Sailors accept offers from the AOs. We turn to the Sailor behavior shortly but we have analyzed the impact on readiness of the incentive packages that are offered to the AOs. In Table 4 we report the results for All Positions Filled which is equal to one if all billets are filled (the ship is ready) and zero otherwise. In general, all of the incentive packages reduce readiness at the ship and the group level as the AOs respond to the incentives by lowering offers and the Sailors respond by rejecting these offers.

Within this general result, some important findings emerge. While tournament incentives do reduce readiness, this effect is most prominent when the Tournament-large is in effect. Since the large tournament had an insignificant effect on costs of filling billets, it would appear that utilizing dramatically large pay-offs in tournaments is counterproductive. In the experiments, the large tournament prize was more than 200% of the baseline compensation to AOs.

Pair-wise tests of the coefficients from the readiness regression indicate that the share of savings and all tournament settings except the large tournament are statistically equivalent at the 0.05 level in terms of readiness reduction relative to the baseline. Overall, the incentive packages that emerge as being the best combination of cost reduction and impact on ship readiness are the small tournament and the share of savings bonus. In our setting, giving the AO the power to set the budget allocation across the billets has no effect on either cost savings or readiness.

Finally, in terms of group readiness, share of savings outperformed all other incentive settings except for the medium tournament ( $p = 0.252$ ).

Since the response of Sailors to the offers directly affects the effectiveness of the incentive packages, the analysis must examine the determinants of the propensity of the Sailor to accept the offer. The results are reported in Table 5. We run separate models for each Sailor type as well as for all Sailors combined. When the AOs and Sailors have better (limited by the fuzzy setting) information of outside options, the Red Sailors are more likely to accept the offers the AOs make. Overall, the better information reduces acceptance probability (as shown by the negative coefficient in the All Sailors estimation). Overall, Green Sailors are less likely to accept the offer. In the All Sailors model, the omitted class is Green Sailor and the coefficients on the remaining classes (Red and Blue) are positive and significant. If the lowered value position (Green) is deemed less necessary to meet, readiness requirements then this finding may be combined with what we learn regarding the AO behavior to expand our analysis of the readiness-cost savings tradeoff.

**Table 5**  
**Sailor Acceptance**

| <b>Independent Variables</b>             | <b>All Sailors</b>  | <b>Red Sailor</b>   | <b>Blue Sailor</b>  | <b>Green Sailor</b> |
|--|---------------------|---------------------|---------------------|---------------------|
| <i>constant</i>                          | 4.20***<br>(0.380)  | 3.46***<br>(0.553)  | 3.34***<br>(0.715)  | 2.14***<br>(0.311)  |
| <i>Lag Sailor Accept</i>                 | -0.22***<br>(0.064) | 0.24**<br>(0.114)   | -0.11<br>(0.118)    | -0.20*<br>(0.105)   |
| <i>Save per Position</i>                 | ---                 | -0.09***<br>(0.008) | -0.16***<br>(0.012) | -0.08***<br>(0.009) |
| <i>Save Total</i>                        | -0.05***<br>(0.003) | ---                 | ---                 | ---                 |
| <i>Blue Last Round</i>                   | 0.10*<br>(0.056)    | 0.13<br>(0.099)     | 0.06<br>(0.102)     | 0.27***<br>(0.102)  |
| <i>Green Last Round</i>                  | 0.10*<br>(0.058)    | 0.02<br>(0.105)     | 0.21*<br>(0.107)    | 0.16<br>(0.099)     |
| <i>AO determines budget per position</i> | 0.09<br>(0.095)     | 0.19<br>(0.134)     | 0.23*<br>(0.134)    | -0.05<br>(0.128)    |
| <i>Limited Information</i>               | -0.12<br>(0.117)    | 0.09<br>(0.160)     | -0.22<br>(0.159)    | 0.02<br>(0.162)     |
| <i>Cumulative Wealth</i>                 | 0.00<br>(0.001)     | 0.00<br>(0.001)     | 0.00<br>(0.001)     | 0.00*<br>(0.001)    |
| <i>Task Time</i>                         | -0.01<br>(0.020)    | -0.22<br>(0.244)    | -0.03<br>(0.166)    | -0.01<br>(0.021)    |
| <i>Age</i>                               | -0.06***<br>(0.016) | 0.01<br>(0.030)     | -0.06***<br>(0.023) | -0.05***<br>(0.020) |
| <i>Male</i>                              | -0.05<br>(0.077)    | -0.22**<br>(0.105)  | -0.04<br>(0.105)    | -0.00<br>(0.105)    |

|                     |                     |        |        |        |
|---------------------|---------------------|--------|--------|--------|
| <i>Blue Sailor</i>  | -0.18***<br>(0.058) | ---    | ---    | ---    |
| <i>Green Sailor</i> | -0.28***<br>(0.070) | ---    | ---    | ---    |
| <i>Observations</i> | 8454                | 2820   | 2818   | 2816   |
| <i>Wald (chi2)</i>  | 453.56              | 154.11 | 201.76 | 140.69 |

Note.

1. estimated using panel probit model (fixed effects for rounds, random effects for subjects)
2. standard are errors in parentheses. \*, \*\*, \*\*\* denote 0.10, 0.05 and 0.01 significance levels, respectively

### c) Cost versus Readiness Tradeoff

Reducing labor costs is the objective of transitioning to a more market oriented staffing process for the Navy. It appears, from our data and analysis, that a compensation mechanism for the AOs that provides incentives to reduce these costs can be effective. However, an unintended consequence may be lower levels of readiness. In our stylized setting ship, readiness is measured in terms of filling all three billets on the ship. We define group readiness to be that at least 75% of the ships be ready (all billets filled). Our setting does not allow for partial readiness of one ship to be compensated by partial or full readiness of another ship, hence our setting imposes a fairly rigorous standard for readiness. We summarize our comparison of the ship readiness-cost savings tradeoff in Figure 2.

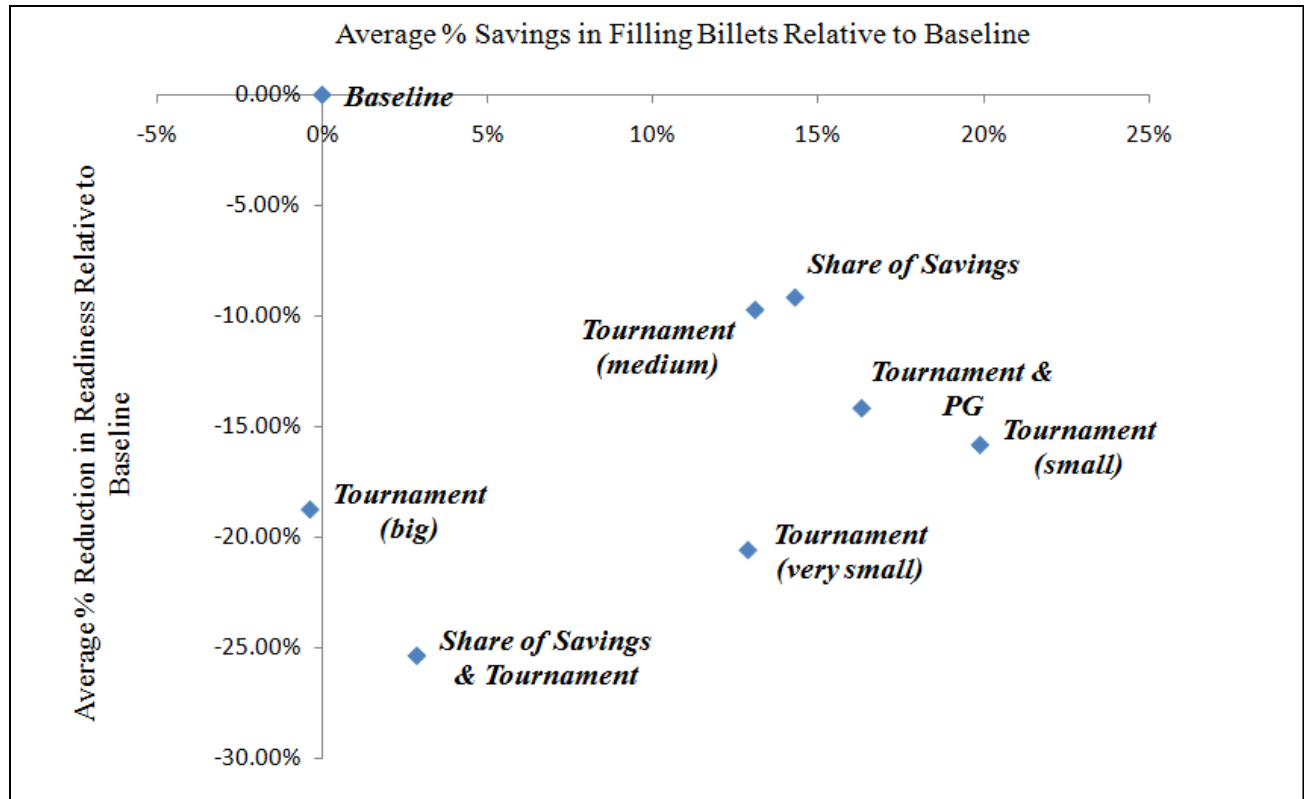
A movement to the right from the Baseline position is unambiguously good – costs fall and readiness remains the same. Similarly, a movement directly below the Baseline is unambiguously bad – costs unchanged and the readiness level falls. Within this range, we see there is scope for tradeoffs. We do not know the underlying weights the Navy would seek to apply to these measures. If ship readiness is the more important objective, the Tournament (medium) and Share of Savings incentives do quite well. Cost saving exceed the percentage fall in readiness.

Given that cost savings are desired and readiness reduction is not, we can say that all **mechanisms yielding outcomes to the south west of “Share of Savings” in Figure 2** are unambiguously less effective. This leaves for further consideration the Tournament (small) and Tournament PG mechanisms. However, both yield significantly lower readiness outcomes at both the ship and the group level.

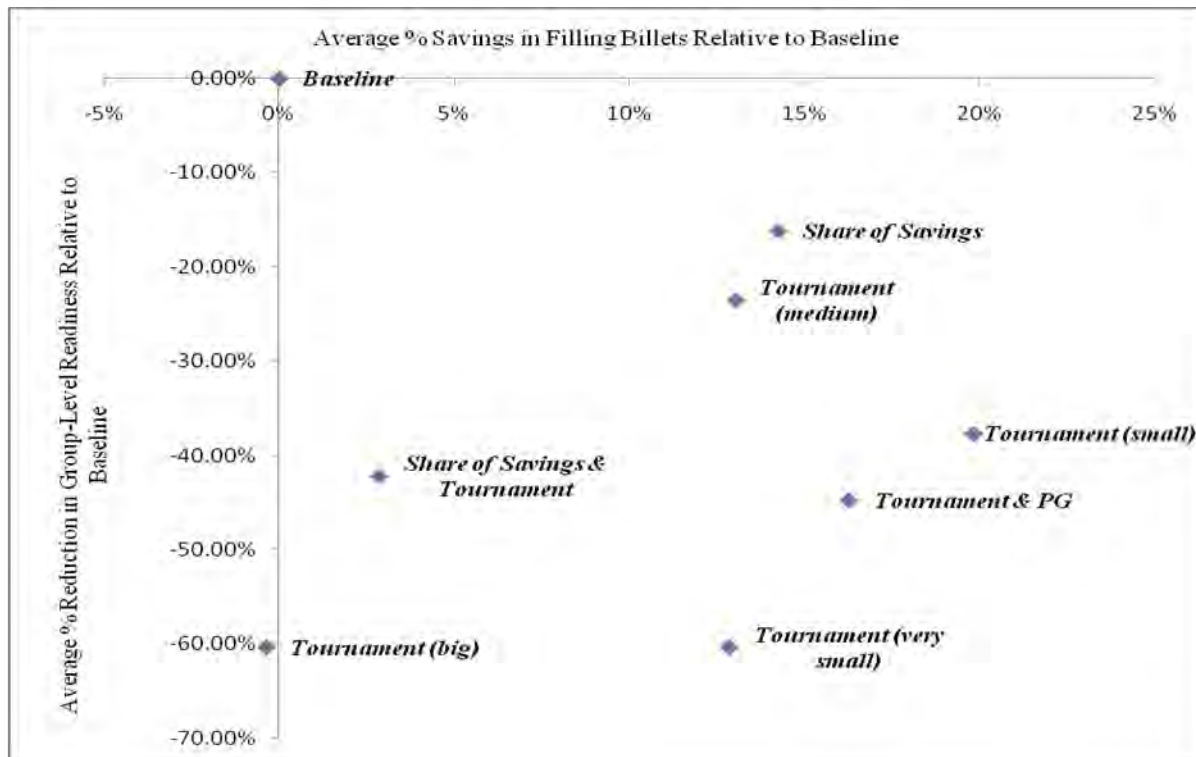
Note that our setting is particularly stringent as far as measuring readiness targets. The AO has only as many Sailors available as there are billets. A rejected offer means the ship is not ready. Two ships failing to meet readiness means the group is not ready. In the field, there are likely to be Sailors available to accept offers that are rejected. That

is, there is a pool of additional labor available. Thus, readiness measures will be much higher in the field setting.

**Figure 2. Comparing Ship Readiness vs. Cost Savings Across Incentive Mechanisms**



**Figure 3. Comparing Group Readiness vs. Cost Savings across Incentive Mechanisms**



## 5. Conclusions and Extensions

We designed a set of laboratory experiments to investigate the effects of AO incentives on readiness and cost savings while filling billets. Our setting is a strong test since there is little room for error on the part of the AO – **there are no “spare” Sailors** so a single rejection implies failure to meet readiness in the current period.

On the other hand, our environment mimics a fluid labor market. Sailors can leave (reject) and return without penalty in the form of lost seniority. In that sense, it can inform the policy debate concerning the effects of moving to a market system for staffing billets in the Navy.

Our results suggest that providing the AO incentives to lower labor costs can be effective. There are costs, measured as reduced readiness rates, but these can be mitigated through the choice of the incentive mechanism. We find that the small and medium sized tournament rewards and offering a share of the saving generate the most effective tradeoff between costs of filling billets and maintaining a level of readiness.

Since our setting imposes strict constraints on filling billets, through the absence of Sailors that may be in a pool of available personnel, we have likely overstated the readiness impacts associated with the introduction of incentive packages for the AO.

**However, we feel that such a conservative approach is consistent with the Navy's** objective of meeting readiness.

There are several avenues that could be explored based on the results we report here. An experiment could be set up where either Sailors > billets. In the current climate, skill specific, this is happening. As discussed above, this situation may affect readiness/costs combination of the mechanisms. We expect that the effect will occur across all mechanisms and is unlikely to affect the ranking of the relative performance across mechanisms. A related question is how the cost versus readiness tradeoff is affected when we hire an additional person beyond perhaps what is needed. This raises the question of the marginal effect on readiness and costs per each additional unit of labor hired.

In none of our settings is the AO budget constrained. That is the budget available is sufficient to meet all outside options available to the Sailors. Rejected offers arise solely when the AO attempts to save from this budget. Thus, allowing the AO a larger budget is unlikely to address the readiness effects. If the AOs continue to respond to the incentives introduced by the performance mechanisms we predict that readiness will decline. Far more likely to improve readiness are such factors as the availability of Sailors in excess of the number of billets available and greater uncertainty in the outside options available to the Sailors. There is also the question that we have not addressed as yet; does varying pay according to ability (broadly defined), as captured in our sorting task, adversely affect the rejection rate among Sailors?





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**Appendix A:**  
**Decision Sequence and**  
**Treatments in the Experiment**

## Appendix A: Decision Sequence and Treatments in the Experiment

**Players:** 1 *AO* (officer) and 3 *Sailors* per group.

**Stage 1:** Rank determination for Sailors / Determining billet values / Offers to Sailors

In each period, players are randomly assigned to a group consisting of 1 *AO* and 3 Sailors. Throughout, Sailors remain Sailors and *AO*s remain *AO*s.

In each period the total budget,  $P$ , is divided into three billet values  $p_R$ ,  $p_G$  and  $p_B$ .

*AO* Treatments in effect this stage:

- a.* – *AO* chooses  $p_R$ ,  $p_B$  and  $p_G$  such that  $p_R + p_B + p_G = P$  and  $p_R \geq p_B \geq p_G$ .
- b.* – The values for  $p_R$ ,  $p_B$  and  $p_G$  are predetermined.
- c.* – Compensation mechanism assigned to the *AO* (described in detail below).

Sailor Treatments in effect at this stage:

- a.* – Sailors earn assignment of rank through the timed number sorting task, earning either the Red, Blue or Green rank. The ranking defines the value of their outside option,  $l_b$ , where  $l_R \geq l_B \geq l_G \geq 0$ . A sailor's outside option is their payoff if they reject the offer from the *AO*.
- b.* – Sailors are randomly assigned to either the Red, Blue or Green rank. Again, the ranking defines the value of their outside option,  $l$ .
- c.* – The degree of precision (fuzziness) associated with the outside option.

While the *AO* is choosing the amount to offer each of the three Sailors ( $o_R$ ,  $o_B$ , and  $o_G$ ) and the budget allocated to the billets (if applicable) the Sailors are completing the rank assignment task (if in effect).

### Stage 2: Sailors accept or reject / *AO*'s payoffs are determined

Sailors are told their ranking; they can view all three billet values in the common knowledge setting but only their own in the limited information setting. They can view their individual offer from the *AO*.

Sailor treatments in effect at this stage:

- a.* – Sailors can view all three offers made by the *AO*
- b.* – Sailors can only view their individual offer from the *AO*

Each Sailor either accepts the offer and receives  $o_b$  or rejects the offer and earns  $l_b$ .

After the three Sailors have made their decisions, the *AO*'s payoffs are determined.

Treatments in effect at this stage:

- a.* *AO* earns  $\$X$  given that all billets are filled, or  $\$Y$  if billet(s) go unfilled, where  $X > Y \geq 0$ .
- b.* *AO* earns  $\$xR + \$yB + \$zG$  where  $R$ ,  $B$  and  $G = 1$  if the respective billets are filled.

*c.* **AO** earns  $\$X$  given that all billets are filled (or based on a formula as in *b* above), **plus** a share,  $\alpha$ , of the surplus from  $P$ , where  $0 \geq \alpha \geq 1$ .

*d.* **AOs** compete among themselves for efficiency in filling billets. To implement this we add a rank order tournament to the **AO** compensation scheme (which could be either of *g*, *h* or *i*. That is, with  $N$  **AOs** in a session, whoever fills the billet assignments at the least cost wins the tournament and earns an additional bonus. That bonus could be a larger share of the surplus.

**Note:** For each of these treatments, we vary whether the Sailors are aware of the **AO's compensation scheme**.

At the end of the period Sailors and **AOs** are informed of their earnings. Here we will want to vary what information about the **other** players each Sailor receives.

Again, the positions in the experimental setting are described as Manager (for the **AO**) and Worker (for the Sailor).

The Readiness Requirement can take two forms: all billets must be filled or specific (essential) billets must be filled. We define Red to be essential to implement the latter setting. An **AO** filling only the Red billet will receive pay but less than if all billets are filled.

Sub-treatment (boundary conditions) components to be investigated in each of these treatments: Fuzzy outside option values; Information settings regarding outside options – full (symmetric) information, partial (asymmetric) information, no information; Information settings – Sailors know/not know **AO** compensation mechanism.

## **Appendix B:**

### **Subject Interface Screens**



## Appendix B: Subject Interface Screens

Note. These screens report a set up for a particular treatment. The interface is essentially the same for all treatments but some of the specific settings change. We begin with the screens used by the experimenter (proctor) for the purposes of setting up the session. During the actual experiment the Windows browser frames are not seen on the screens.

The screens shown here are from the instruction phase of the experiment. This the pop-up boxes that inform the participants of the decision setting are shown.

### Proctor's Screens

Setup Menu for Experiment - Windows Internet Explorer

http://econlabdev/home/BilletAssignmentGame/startexperiment.cfm

File Edit View Favorites Tools Help

Links Adobe Connect Apla BSC Email Customize Links Dept Test Dictionary Econlabdev Google Jones-O-Web OBPC Weather Second Life

Setup Menu for Experiment

**DO NOT CHANGE ANYTHING ON THIS PAGE OR CLICK PROCEED UNTIL YOU HAVE SAVED THE RESULTS FROM THE PREVIOUS SESSION!**

**Billet Assignment Experiment Setup**  
fuzzy

**Groups and Subjects**  
1 Groups (4 Subjects)

**Institutions**  
5 Show Up Fee (\$US)  
100 Exchange Rate (\$LAB to one \$US)  
90 AO Alert Time (seconds)  
30 Sailor Alert Time (seconds)  
☐ Trust Game w/Marginal Amount of (\$US) 0.5  
☐ Risk Aversion Test w/ Sure Bet (\$US) 2.5

**AO Compensation**  
Lump Sum  
15.0 Red-Blue-Green Filled (\$LAB)  
10.0 Red-Blue Filled (\$LAB)  
5.0 Red Filled (\$LAB)  
OR  
Position Multiplier  
9.0 Red (\$LAB)  
7.0 Blue (\$LAB)  
5.0 Green (\$LAB)  
☒ AO Share Bonus 25.0 (% of Saved when Position filled)  
☒ AO Least Cost Tournament Bonus 30.0 (\$LAB)  
☒ Critical Red Position (must be filled or zero compensation)

**The Series Attributes**

|          | 5 Rounds | Sort                                | P     | $p_R$ | $p_B$ | $p_G$ | $P_{USB}$                           | $O_R$ | $O_B$ | $O_G$ | Fzy                                 | $\sigma(\%)$ | $\pi_{02s}$                         | $\pi_{02a}$                         | $\pi_{02s}$                         | $\pi_{02a}$                         |
|----------|----------|-------------------------------------|-------|-------|-------|-------|-------------------------------------|-------|-------|-------|-------------------------------------|--------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Training | 2        | <input checked="" type="checkbox"/> | 95.0  | 40.0  | 30.0  | 25.0  | <input checked="" type="checkbox"/> | 41.0  | 31.0  | 26.0  | <input checked="" type="checkbox"/> | 3.0          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Series 2 | 3        | <input checked="" type="checkbox"/> | 100.0 | 40.0  | 35.0  | 25.0  | <input checked="" type="checkbox"/> | 42.0  | 36.0  | 27.0  | <input checked="" type="checkbox"/> | 2.0          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Series 3 | 0        | <input type="checkbox"/>            | 99.0  | 33.0  | 33.0  | 33.0  | <input type="checkbox"/>            | 35.0  | 35.0  | 35.0  | <input type="checkbox"/>            | 3.0          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Series 4 | 0        | <input type="checkbox"/>            | 94.0  | 35.0  | 31.0  | 28.0  | <input type="checkbox"/>            | 35.0  | 31.0  | 28.0  | <input type="checkbox"/>            | 2.0          | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |
| Series 5 | 0        | <input type="checkbox"/>            | 103.0 | 40.0  | 34.0  | 29.0  | <input type="checkbox"/>            | 40.0  | 34.0  | 29.0  | <input type="checkbox"/>            | 4.0          | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |

**Treatments**  
Delete Select A Treatment Save  
Proceed

Done Trusted sites 100%

Setup Menu for Experiment - Windows Internet Explorer

http://econlabdev/home/BilletAssignmentGame/startexperiment.cfm

File Edit View Favorites Tools Help

Links Adobe Connect Apla BSC Email Customize Links Dept Test Dictionary Econlabdev Google Jones-O-Web OBPC Weather Sec

Setup Menu for Experiment

90 AO Alert Time (seconds)

30 Sailor Alert Time (seconds)

☐ Trust Game w/Marginal Amount of (\$US) 0.5

☐ Risk Aversion Test w/ Sure Bet (\$US) 2.5

☒ AO Share Bonus 25.0 (% of Saved when Position filled)

☒ AO Least Cost Tournament Bonus 30.0 (\$LAB)

☒ Critical Red Position (must be filled or zero compensation)

The Series Attributes

|          | 5 Rounds | Sort                                | P     | $p_R$ | $p_B$ | $p_G$ | $P_{USE}$                           | $O_R$ | $O_B$ | $O_G$ | Fzy                                 | $\varepsilon(\%)$ | $\pi_{02s}$                         | $\pi_{02a}$                         | $\pi_{p2s}$                         | $\pi_{p2a}$                         |
|----------|----------|-------------------------------------|-------|-------|-------|-------|-------------------------------------|-------|-------|-------|-------------------------------------|-------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Training | 2        | <input checked="" type="checkbox"/> | 95.0  | 40.0  | 30.0  | 25.0  | <input checked="" type="checkbox"/> | 41.0  | 31.0  | 26.0  | <input checked="" type="checkbox"/> | 3.0               | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Series 2 | 3        | <input checked="" type="checkbox"/> | 100.0 | 40.0  | 35.0  | 25.0  | <input checked="" type="checkbox"/> | 42.0  | 36.0  | 27.0  | <input checked="" type="checkbox"/> | 2.0               | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Series 3 | 0        | <input type="checkbox"/>            | 99.0  | 33.0  | 33.0  | 33.0  | <input type="checkbox"/>            | 35.0  | 35.0  | 35.0  | <input type="checkbox"/>            | 3.0               | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Series 4 | 0        | <input type="checkbox"/>            | 94.0  | 35.0  | 31.0  | 28.0  | <input type="checkbox"/>            | 35.0  | 31.0  | 28.0  | <input type="checkbox"/>            | 2.0               | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |
| Series 5 | 0        | <input type="checkbox"/>            | 103.0 | 40.0  | 34.0  | 29.0  | <input type="checkbox"/>            | 40.0  | 34.0  | 29.0  | <input type="checkbox"/>            | 4.0               | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |

Treatments

Delete Select A Treatment Save

Proceed

The Series Attributes Legend

Sort = use Sort Task for positions  $P_{USE}$  = use the values for  $p_{RED}$ ,  $p_{BLUE}$ ,  $p_{GREEN}$   $\varepsilon$  = % margin of error

P = manager's budget  $O_R$  = outside red  $\pi_{02s}$  = show all offers to sailors

$p_R$  = position red  $O_B$  = outside blue  $\pi_{02a}$  = show all offers to aos

$p_B$  = position blue  $O_G$  = outside green  $\pi_{p2s}$  = show all payoffstosailors

$p_G$  = position green  $Fzy$  = use random value within margin of error  $\pi_{p2a}$  = show all payoffs to aos

Done Trusted sites

Premonitor - Windows Internet Explorer

http://econlabdev/home/BilletAssignmentGame/premonitor.cfm

File Edit View Favorites Tools Help

Links Adobe Connect Apla BSC Email Customize Links Dept Test Dictionary Econlabdev Google Jones-O-Web OBPC Weather Second Life

Premonitor

### Proctor's Pre-session Monitor

**Subjects Are Not Finished With Basic Instructions!**

The database has been started and is ready for the session to start. Now is the time to have subjects begin reading instructions on their laptops. As soon as everyone has gotten past the basic instructions and games (if included), the monitor page will appear and the session will be underway.

#### Configuration

Treatment Name: fuzzy

##### Groups and Subjects

Groups: 1

##### Institutions

Show Up Fee (\$US): 5  
Exchange Rate (\$LAB to one \$US): 100  
AO Alert Time (seconds): 90  
Sallor Alert Time (seconds): 30  
Trust Game: no w/Marginal Amount of (\$US) 0.5  
Risk Aversion Test: no w/ Sure Bet (\$US) 2.5

##### AO Compensation

☐ Lump Sum  
Red-Blue-Green Filled: 15.0 (\$LAB)  
Red-Blue Filled: 10.0 (\$LAB)  
Red Filled: 5.0 (\$LAB)

OR

☐ Position Multiplier  
Red: 9.0 (\$LAB)  
Blue: 7.0 (\$LAB)  
Green: 5.0 (\$LAB)

AO Share Bonus: yes Bonus= 25.0 (% of Saved when Position filled)  
AO Least Cost Tournament Bonus: yes Bonus= 30.0 (\$LAB)  
Critical Red Position: yes

#### Subject Role Ready

|   |    |    |
|---|----|----|
| 1 | AO | NO |
| 2 | W  | NO |
| 3 | W  | NO |
| 4 | W  | NO |

postmonitor.cfm - Windows Internet Explorer

http://econlabdev/home/BilletAssignmentGame/postmonitor.cfm

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postmonitor.cfm

### Post Session Monitor

Subjects are reviewing the results of the risk and trust games (if they existed) and entering their answers to the demographics.

#### Configuration

Treatment Name: fuzzy

##### Groups and Subjects

Groups: 1

##### Institutions

Show Up Fee (\$US): 5  
Exchange Rate (\$LAB to one \$US): 100  
AO Alert Time (seconds): 90  
Sailor Alert Time (seconds): 30  
Trust Game: no w/Marginal Amount of (\$US) 0.5  
Risk Aversion Test: no w/ Sure Bet (\$US) 2.5

##### AO Compensation

☒ Lump Sum  
Red-Blue-Green Filled: 15.0 (\$LAB)  
Red-Blue Filled: 10.0 (\$LAB)  
Red Filled: 5.0 (\$LAB)

OR

☐ Position Multiplier  
Red: 9.0 (\$LAB)  
Blue: 7.0 (\$LAB)  
Green: 5.0 (\$LAB)

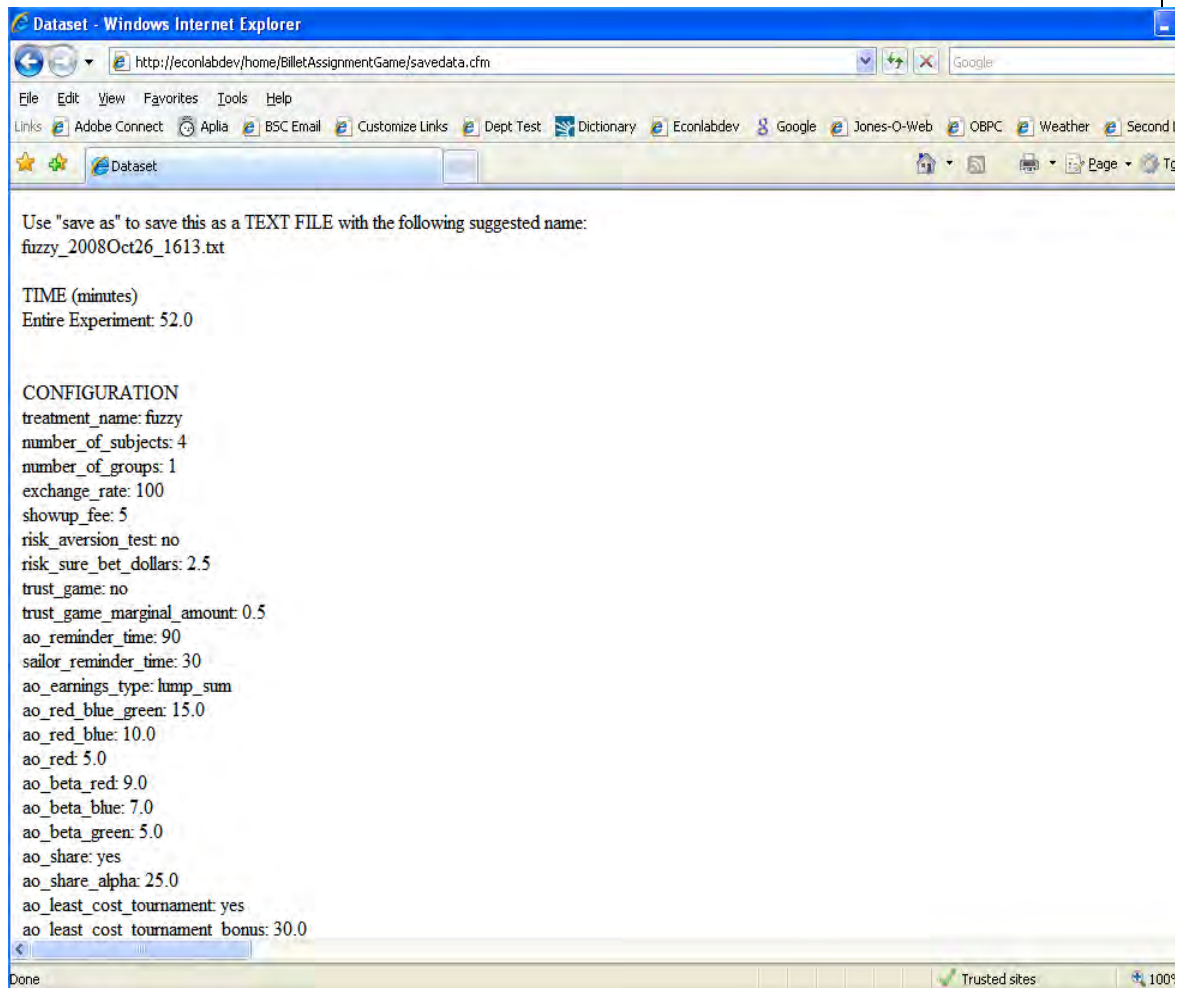
AO Share Bonus: yes Bonus= 25.0 (% of Saved when Position filled)  
AO Least Cost Tournament Bonus: yes Bonus= 30.0 (\$LAB)  
Critical Red Position: yes

#### Subject Finished

1 NO  
2 NO  
3 NO  
4 NO

#### The Series Attributes

|          | 5<br>Rounds | Sort | P     | $p_R$ | $p_B$ | $p_G$ | $P_{USB}$ | $O_R$ | $O_B$ | $O_G$ | Fzy | $\delta(\%)$ | $\pi_{0.2s}$ | $\pi_{0.2a}$ | $\pi_{p.2s}$ | $\pi_{p.2a}$ |
|----------|-------------|------|-------|-------|-------|-------|-----------|-------|-------|-------|-----|--------------|--------------|--------------|--------------|--------------|
| Training | 2           | yes  | 95.0  | 40.0  | 30.0  | 25.0  | yes       | 41.0  | 31.0  | 26.0  | yes | 3.0          | show         | show         | show         | show         |
| Series 2 | 3           | yes  | 100.0 | 40.0  | 35.0  | 25.0  | yes       | 42.0  | 36.0  | 27.0  | yes | 2.0          | show         | show         | show         | show         |
| Series 3 | 0           | no   | 99.0  | 33.0  | 33.0  | 33.0  | no        | 35.0  | 35.0  | 35.0  | no  | 3.0          | show         | show         | show         | show         |
| Series 4 | 0           | no   | 94.0  | 35.0  | 31.0  | 28.0  | no        | 35.0  | 31.0  | 28.0  | no  | 2.0          | show         | noshow       | noshow       | noshow       |
| Series 5 | 0           | no   | 103.0 | 40.0  | 34.0  | 29.0  | no        | 40.0  | 34.0  | 29.0  | no  | 4.0          | show         | noshow       | noshow       | noshow       |

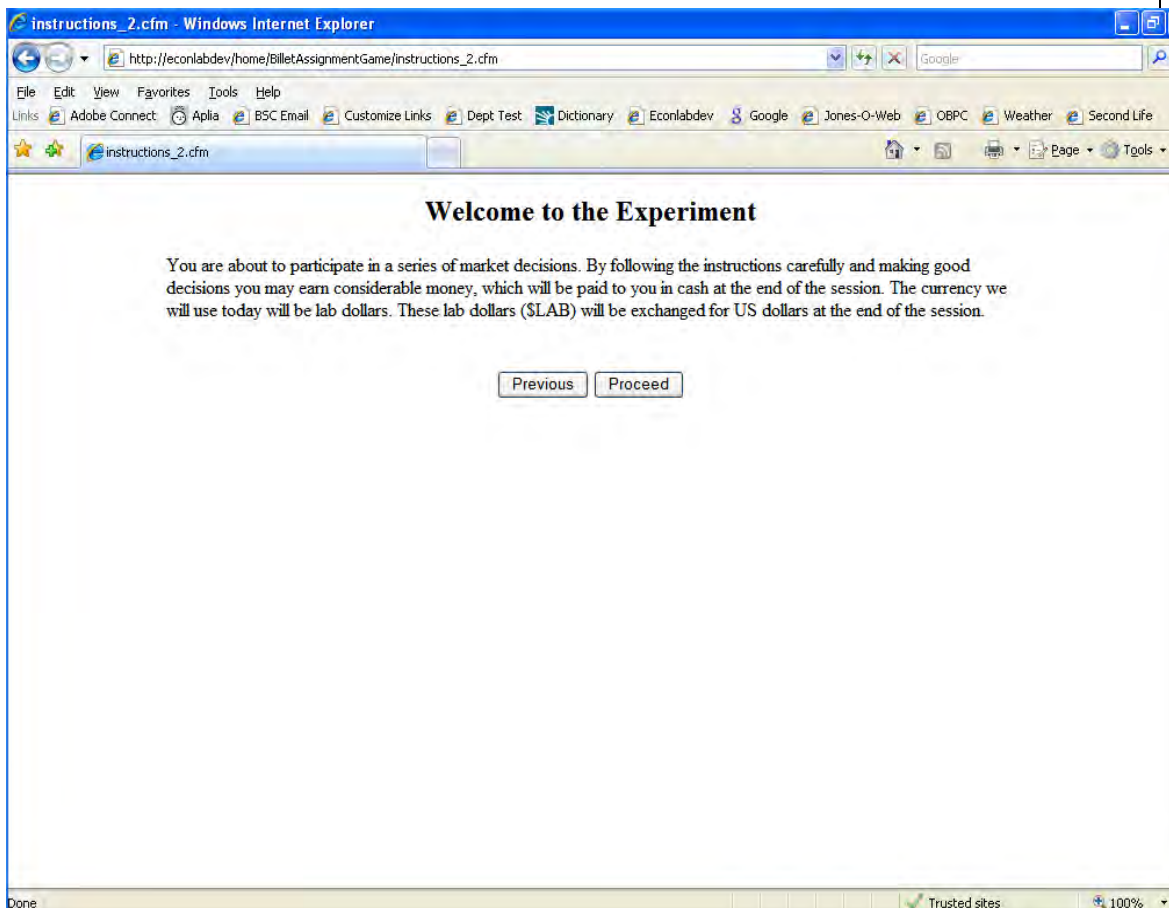
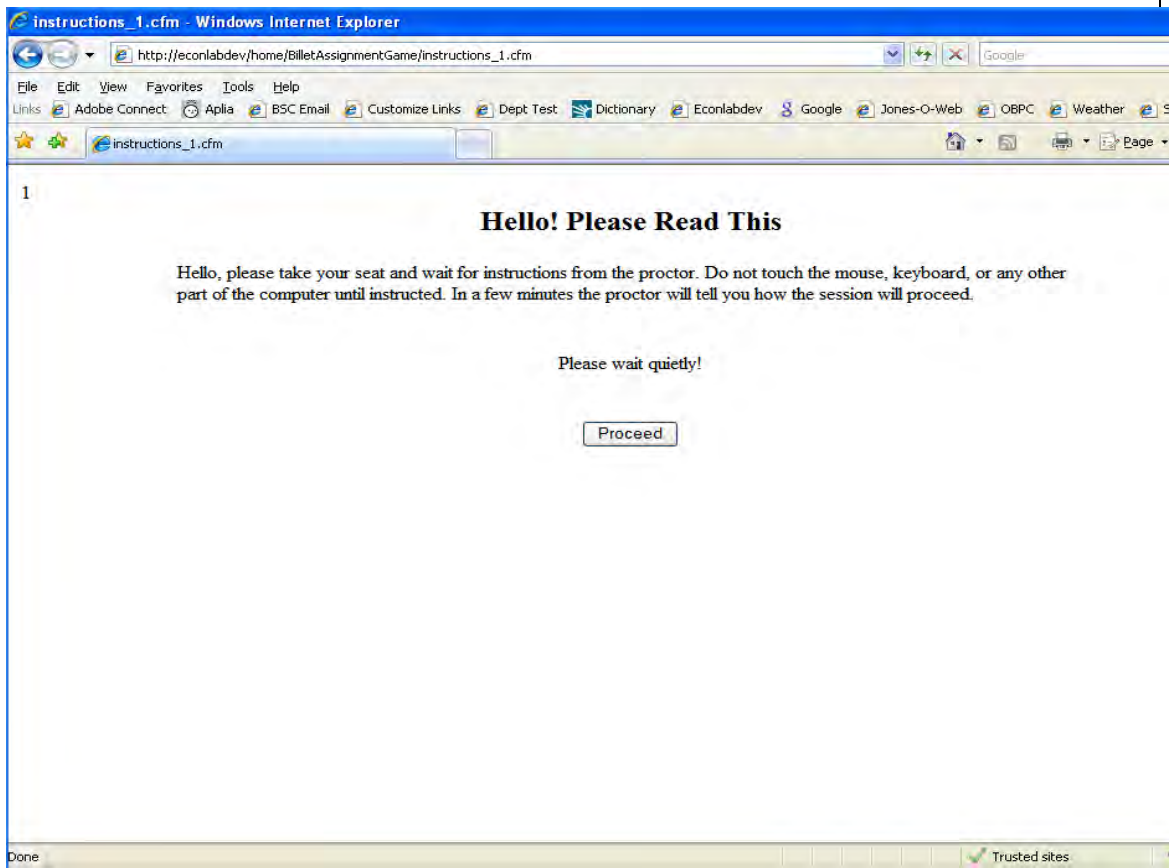


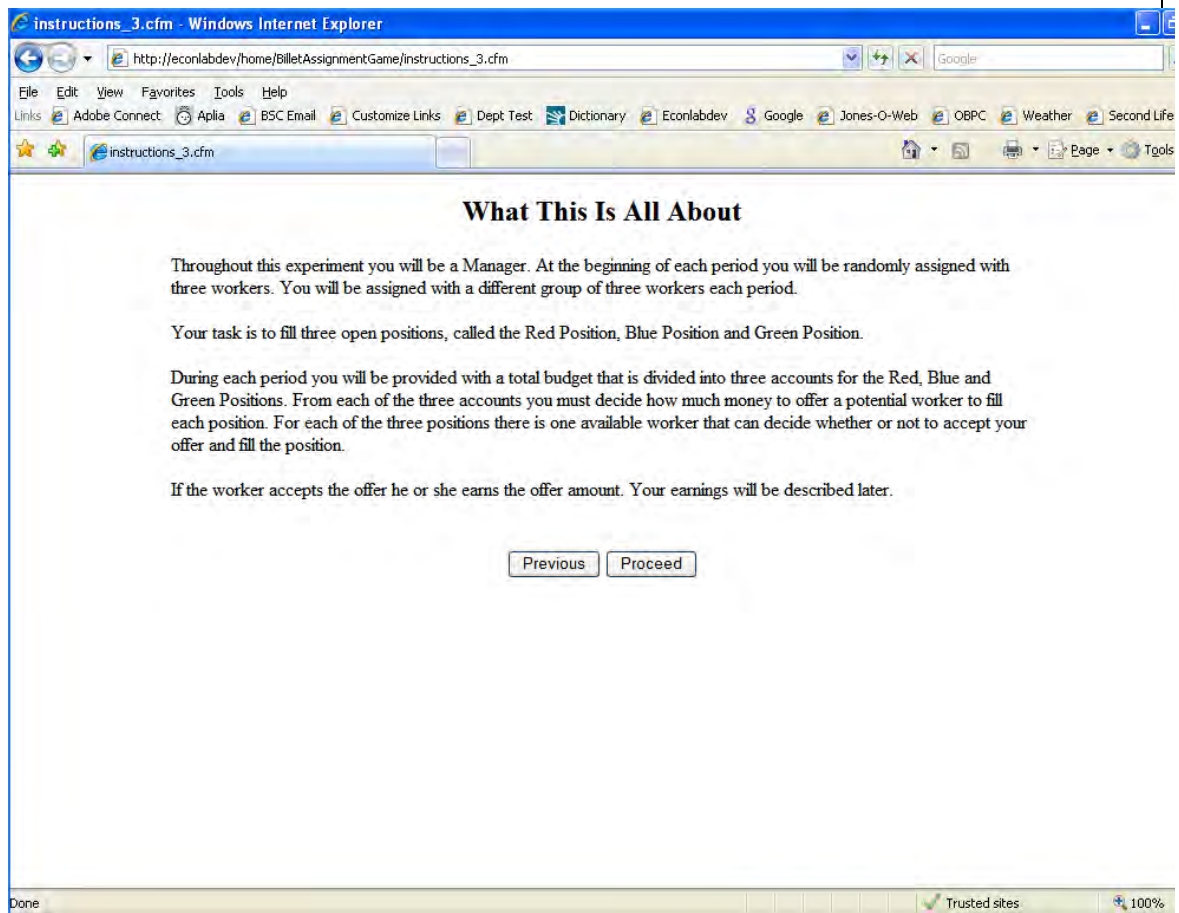
Note. The first part of the dataset generated by the experiment. All treatment elements are recorded.



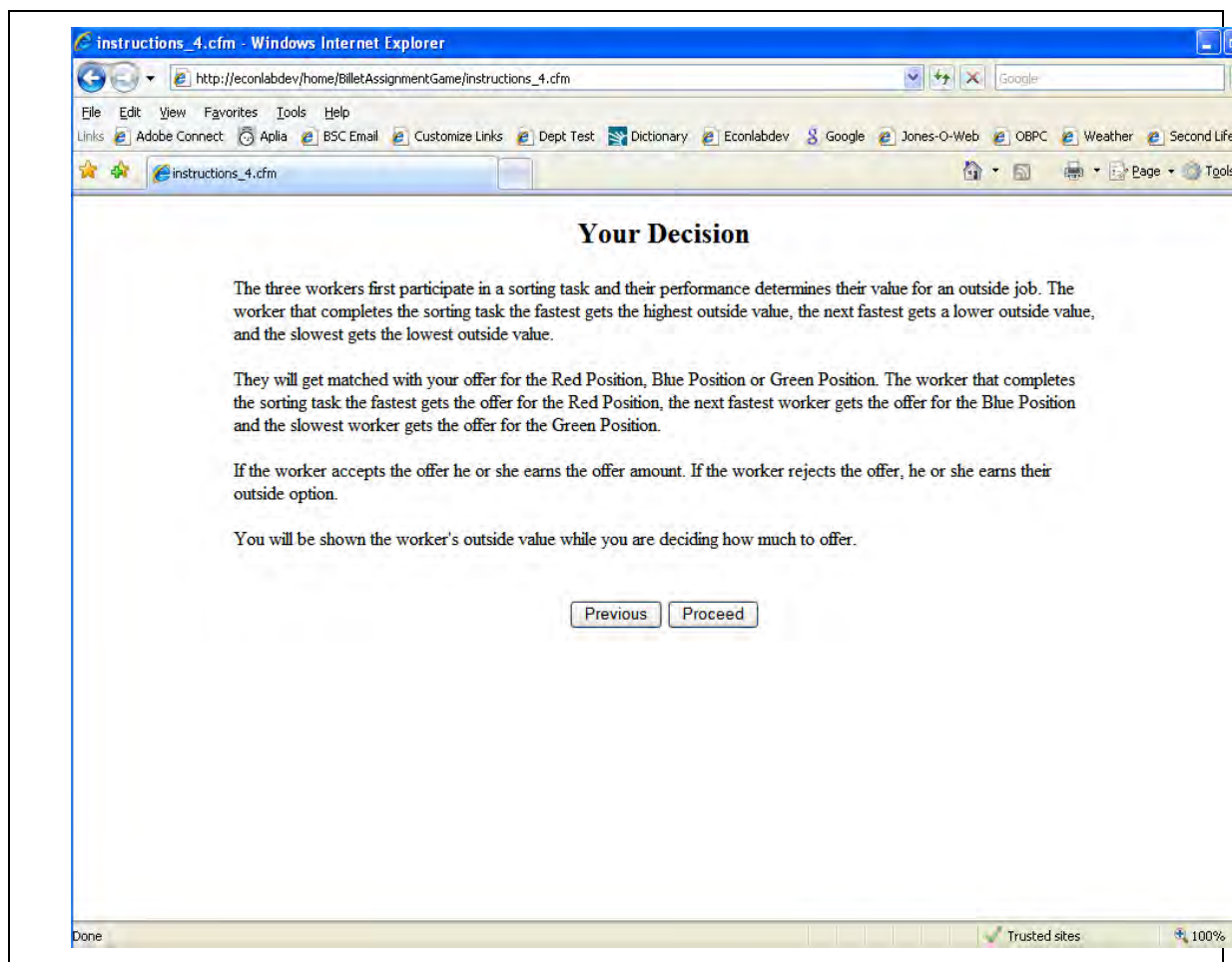


## Manager's Screens (We labeled the AO as Manager for the experiment session)

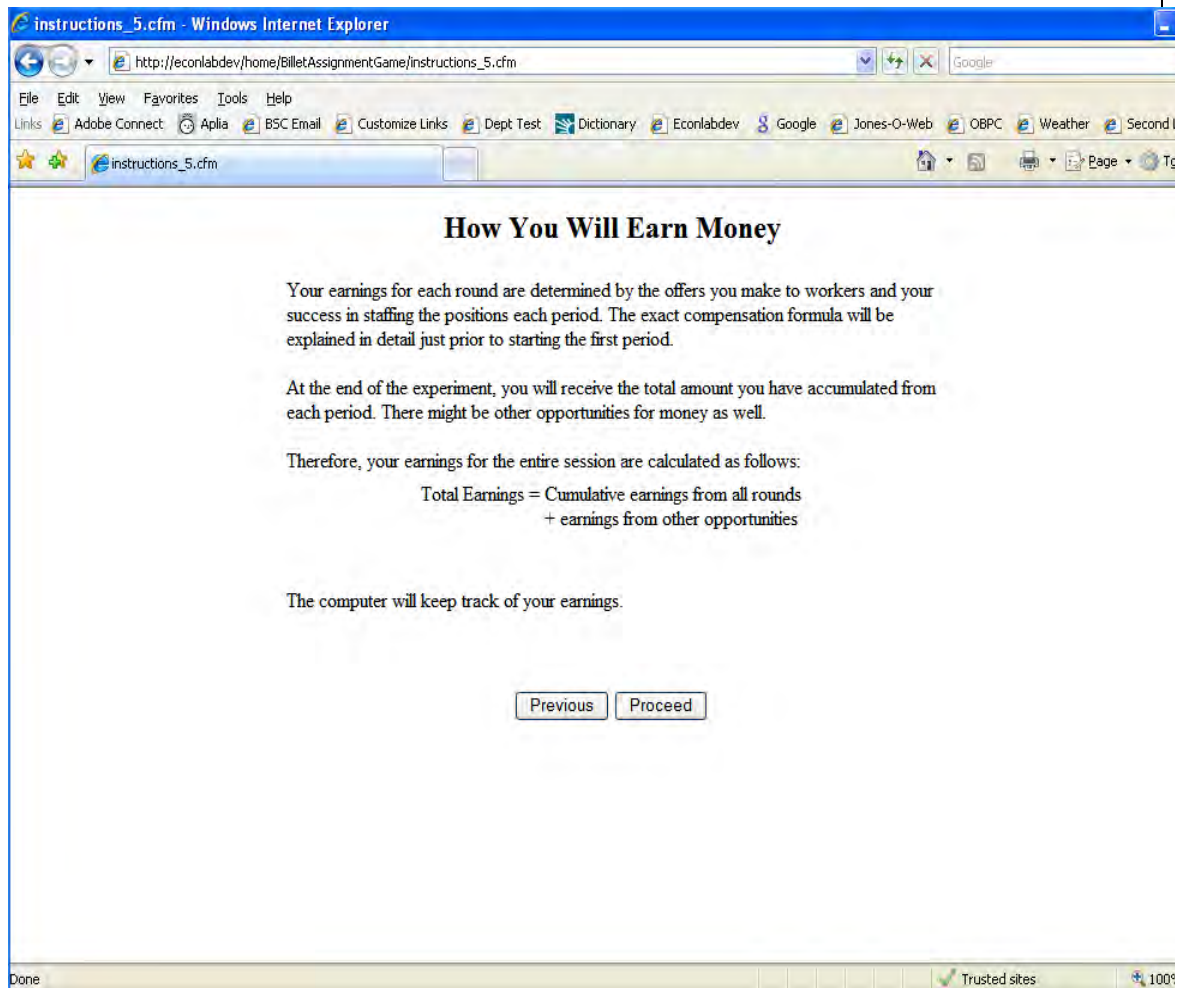


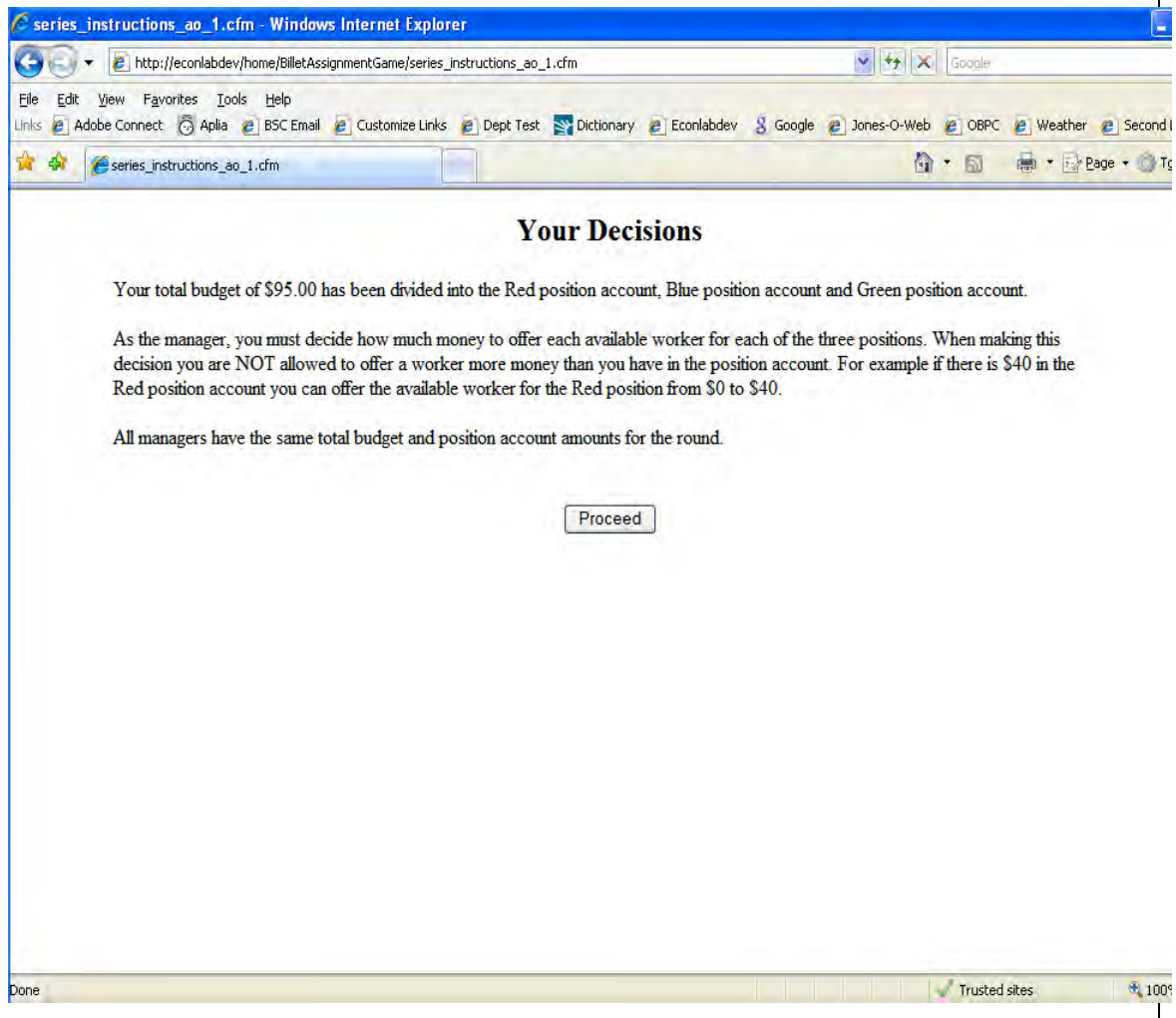


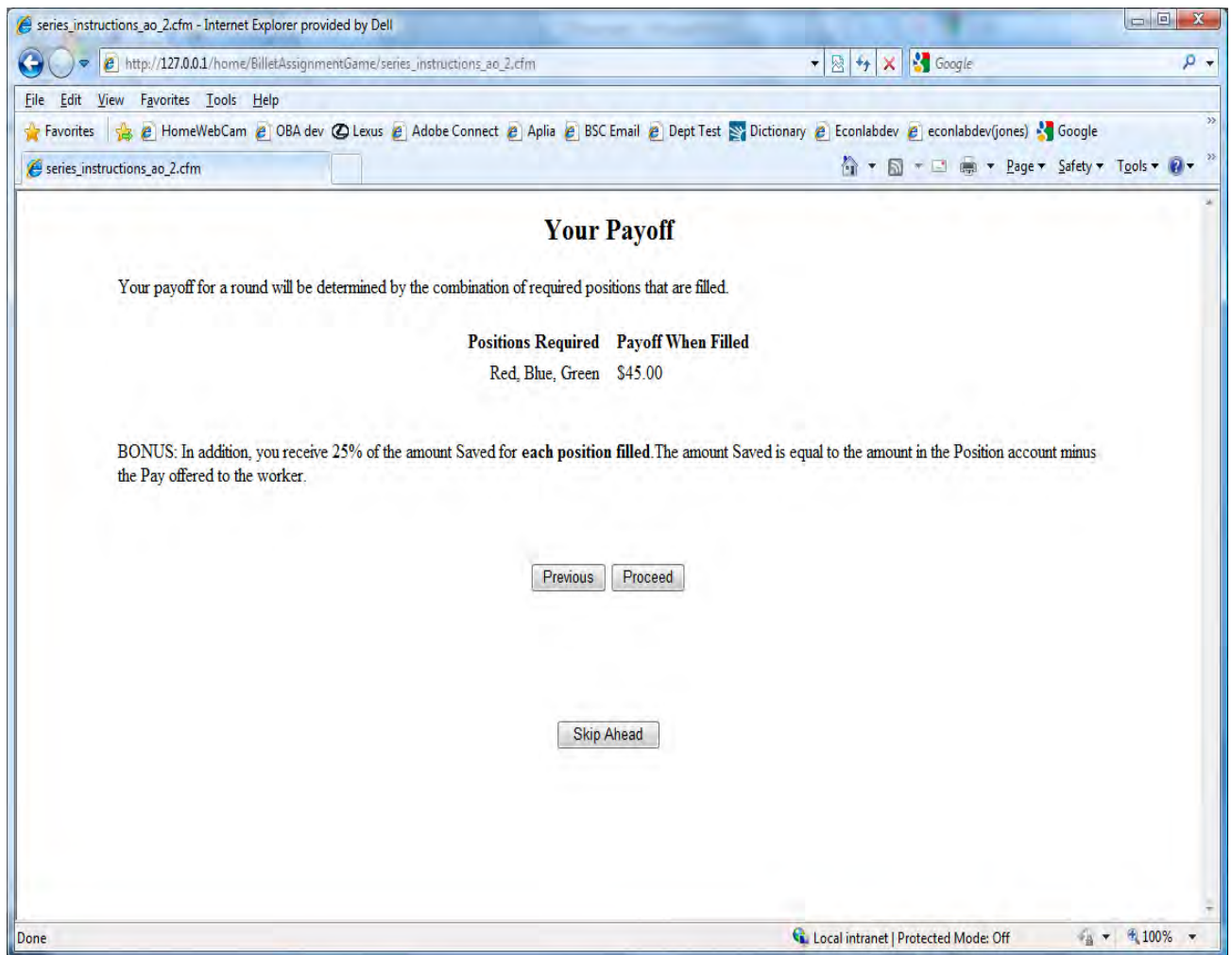




Note. The experiment utilized fairly neutral language; “Managers” instead of AOs and “Workers” instead of Sailors. This is common practice in the setup of lab experiments.







Note. Here the Manager (AO) is informed of the calculation of the payoff to his/her decisions. In the setting shown, the Manager receives a base pay only if all three billets are filled and a bonus equal to 25% of the amount saved (budget minus aggregate wage offers for the 3 billets).

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series\_instructions\_ao\_3.cfm

## The Screen

**Subject 1** Trainin

**Previous Round**

| Manager's Payoff |     | Positions | Potential<br>Save | Offer | Accept or Reject     | Outside<br>Actual | Payoff |
|------------------|-----|-----------|-------------------|-------|----------------------|-------------------|--------|
| Pay              | xxx | xxx       | xxx               | xxx   | ← Accept or Reject → | xxx               | xxx    |
| Bonus            | xxx | xxx       | xxx               | xxx   | ← Accept or Reject → | xxx               | xxx    |
| Total            | xxx | xxx       | xxx               | xxx   | ← Accept or Reject → | xxx               | xxx    |

Manager's Budget xxx

**Current Round**

Manager's Budget 95

|          |    |    |         |   |                  |          |
|----------|----|----|---------|---|------------------|----------|
|          | 30 | 30 | < [ ] > | 0 | Accept or Reject | 40 to 42 |
| Totals = | 95 | 95 | 0       | 0 | Accept or Reject | 30 to 32 |
|          | 25 | 25 | < [ ] > | 0 | Accept or Reject | 25 to 27 |

Outside Range

Submit

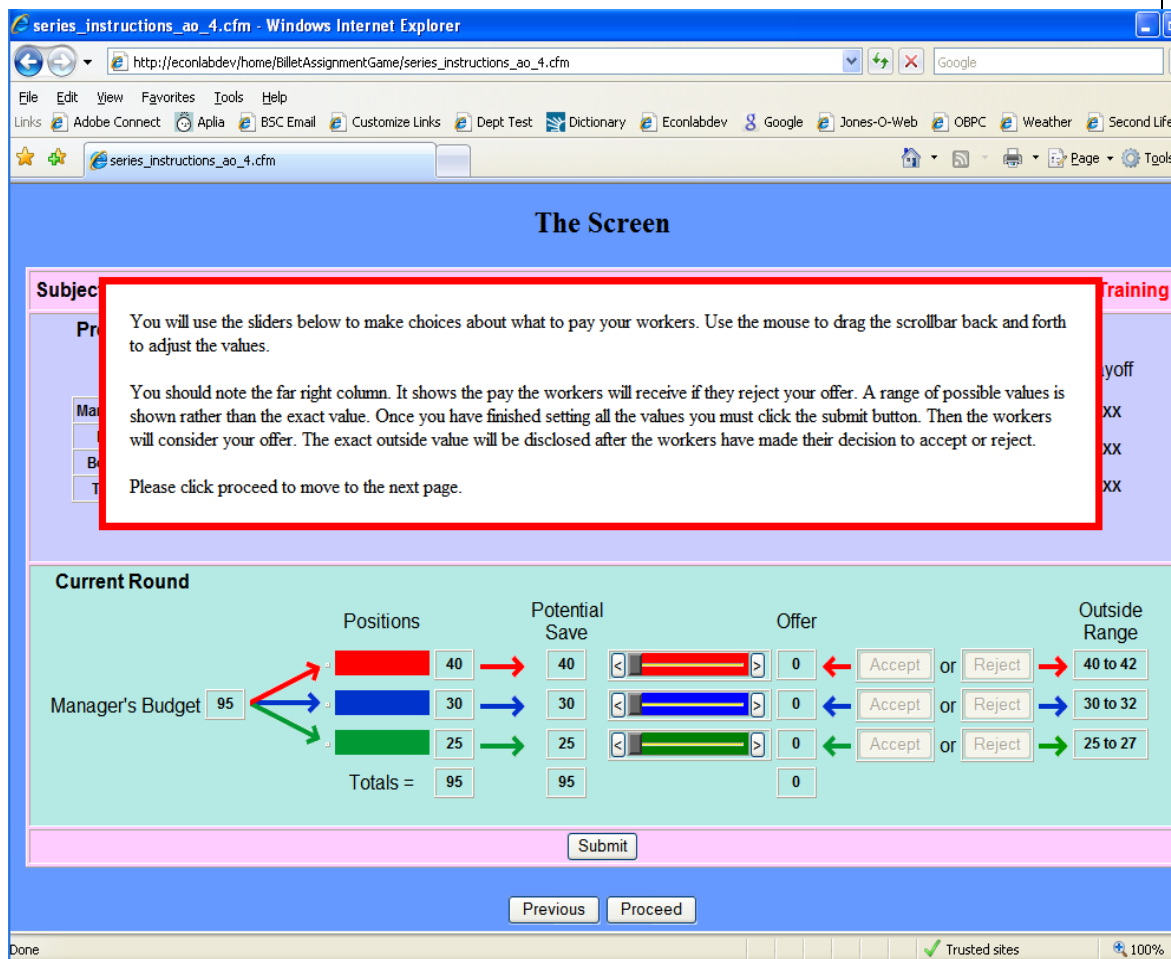
Previous Proceed

The main screen you will use during each round will have a variety of information. It is shown behind this message and will be explained in detail over the next few pages.

Please click proceed to move to the next page.

Done

Trusted sites 100%



Note. In this and the following screens the budget has been allocated across the billets and the AO is now ready to enter offers that will be made to the Sailors assigned to a Red, Blue, or Green billet. The offers (as well as the billet budget allocation) are made by moving the sliders.



series\_instructions\_ao\_5.cfm - Windows Internet Explorer

http://econlabdev/home/BilletAssignmentGame/series\_instructions\_ao\_5.cfm

The Screen

**Subject 1** Trainin

**Previous Round**

The **Manager's Budget** tells you the total amount being allocated to the three positions.

Please click proceed to move to the next page.

|       | Positions | Potential Save | Offer | Accept or Reject     | Outside Actual | Payoff |
|-------|-----------|----------------|-------|----------------------|----------------|--------|
| S xxx | xxx       | xxx            | xxx   | ← Accept or Reject → | xxx            | xxx    |
|       | xxx       | xxx            | xxx   | ← Accept or Reject → | xxx            | xxx    |
|       | xxx       | xxx            | xxx   | ← Accept or Reject → | xxx            | xxx    |
|       | Totals =  | xxx            | xxx   |                      |                |        |

|                     | Positions | Potential Save | Offer             | Accept or Reject | Outside Range |
|---------------------|-----------|----------------|-------------------|------------------|---------------|
| Manager's Budget 95 | 40        | 40             | < [red bar] > 0   | Accept or Reject | 40 to 42      |
|                     | 30        | 30             | < [blue bar] > 0  | Accept or Reject | 30 to 32      |
|                     | 25        | 25             | < [green bar] > 0 | Accept or Reject | 25 to 27      |
|                     | Totals =  | 95             | 0                 |                  |               |

Submit

Previous Proceed

Done Trusted sites 100%

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series\_instructions\_ao\_6.cfm

## The Screen

**Subject 1** Training

**Previous Round**

| Manager's Payoff |     |
|------------------|-----|
| Pay              | XXX |
| Bonus            | XXX |
| Total            | XXX |

The **Position** accounts show how the Budget has been allocated.

Please click proceed to move to the next page.

| Positions | Potential Save | Offer                    | Outside Actual | Payoff |
|-----------|----------------|--------------------------|----------------|--------|
| XXX →     | XXX            | XXX ← Accept or Reject → | XXX            | XXX    |
| XXX →     | XXX            | XXX ← Accept or Reject → | XXX            | XXX    |
| XXX →     | XXX            | XXX ← Accept or Reject → | XXX            | XXX    |
| XXX       | XXX            | XXX                      |                |        |

**Current Round**

Manager's Budget 95

| Positions   | Potential Save | Offer  | Outside Range |
|---|----------------|--|---------------|
| <div style="width: 40px; height: 10px; background-color: red; border: 1px solid black;"></div> 40   | 40             | <div style="width: 40px; height: 10px; background-color: red; border: 1px solid black;"></div> 0   | 40 to 42      |
| <div style="width: 30px; height: 10px; background-color: blue; border: 1px solid black;"></div> 30  | 30             | <div style="width: 30px; height: 10px; background-color: blue; border: 1px solid black;"></div> 0  | 30 to 32      |
| <div style="width: 25px; height: 10px; background-color: green; border: 1px solid black;"></div> 25 | 25             | <div style="width: 25px; height: 10px; background-color: green; border: 1px solid black;"></div> 0 | 25 to 27      |
| Totals = 95   | 95             | 0  |               |

Done Trusted sites 100%



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http://econlabdev/home/BilletAssignmentGame/series\_instructions\_ao\_7.cfm

The Screen

Subject 1 Training

**Previous Round**

Manager's Payoff

|       |     |
|-------|-----|
| Pay   | XXX |
| Bonus | XXX |
| Total | XXX |

Manager's Budget xxx

Positions

Potential Save

Outside Actual Payoff

Reject → XXX XXX

Reject → XXX XXX

Reject → XXX XXX

Totals = xxx

You assign the **Offer** for each worker using the sliders. Potential Save is equal to the Position amount minus the Offer. Please click proceed to move to the next page.

**Current Round**

Manager's Budget 95

Positions

Potential Save

Offer

Outside Range

40 → 40 → 0 → Accept or Reject → 40 to 42

30 → 30 → 0 → Accept or Reject → 30 to 32

25 → 25 → 0 → Accept or Reject → 25 to 27

Totals = 95 95 0

Submit

Previous Proceed

series\_instructions\_ao\_8.cfm - Windows Internet Explorer

http://econlabdev/home/BilletAssignmentGame/series\_instructions\_ao\_8.cfm

The Screen

Subject 1 Training

**Previous Round**

Manager's Payoff

|       |     |
|-------|-----|
| Pay   | XXX |
| Bonus | XXX |
| Total | XXX |

Manager's Budget xxx

Positions

Potential Save

Offer

Outside Actual Payoff

Each worker will decide to Accept the Offer or to take the **Outside** option. Please click proceed to move to the next page.

**Current Round**

Manager's Budget 95

Positions

Potential Save

Offer

Outside Range

40 → 40 → 0 → Accept or Reject → 40 to 42

30 → 30 → 0 → Accept or Reject → 30 to 32

25 → 25 → 0 → Accept or Reject → 25 to 27

Totals = 95 95 0

Submit

Previous Proceed

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series\_instructions\_ao\_9.cfm

## The Screen

**Subject 1** Trainin

**Previous Round**

| Manager's Payoff |     | Positions | Potential Save | Offer | Outside Actual | Payoff |
|------------------|-----|-----------|----------------|-------|----------------|--------|
| Pay              | xxx | xxx       | xxx            | xxx   | xxx            | xxx    |
| Bonus            | xxx | xxx       | xxx            | xxx   | xxx            | xxx    |
| Total            | xxx | xxx       | xxx            | xxx   | xxx            | xxx    |
| Totals =         |     | xxx       | xxx            | xxx   |                |        |

Manager's Budget xxx

Accept or Reject

**Current Round**

On the upper part of the screen you will see information about the previous round. It will show you how your decision worked out.

Please click proceed to move to the next page.

Manager's Budget

|          |    |    |   |   |   |   |   |
|----------|----|----|---|---|---|---|---|
|          | 25 | 25 | 0 | 0 | 0 | 0 | 0 |
| Totals = | 95 | 95 |   |   |   |   |   |

Outside Range

|  |          |          |          |
|--|----------|----------|----------|
|  | 40 to 42 | 30 to 32 | 25 to 27 |
|--|----------|----------|----------|

Submit

Previous Proceed

Done Trusted sites 100%

subjectpage\_ao\_offer.cfm - Windows Internet Explorer

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subjectpage\_ao\_offer.cfm

### Subject 1 Training

#### Previous Round

| Manager's Payoff |     | Manager's Budget xxx | Positions | Potential Save | Offer | Accept or Reject     | Outside Actual       | Payoff |
|------------------|-----|----------------------|-----------|----------------|-------|----------------------|----------------------|--------|
| Pay              | xxx |                      | xxx       | xxx            | xxx   | xxx                  | ← Accept or Reject → | xxx    |
| Bonus            | xxx | xxx                  |           | xxx            | xxx   | ← Accept or Reject → | xxx                  | xxx    |
| Total            | xxx | xxx                  |           | xxx            | xxx   | ← Accept or Reject → | xxx                  | xxx    |
|                  |     |                      | Totals =  | xxx            | xxx   |                      |                      |        |

#### Current Round

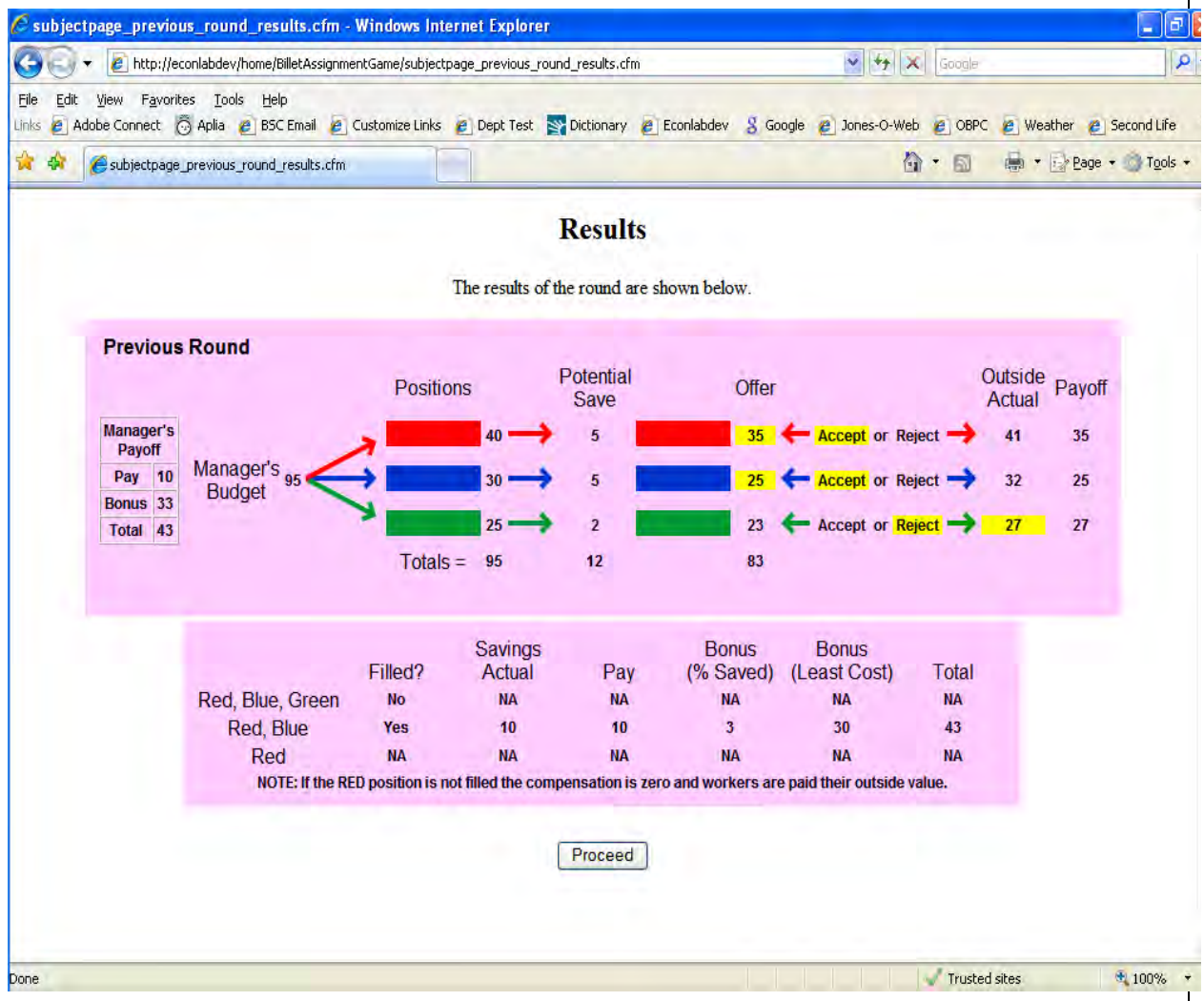
| Manager's Budget 0 |   | Positions | Potential Save | Offer | Accept or Reject | Outside Range |
|--------------------|---|-----------|----------------|-------|------------------|---------------|
| Manager's Budget 0 | 0 | 40        | 5              | 35    | Accept or Reject | 40 to 42      |
|                    |   | 30        | 5              | 25    | Accept or Reject | 30 to 32      |
|                    |   | 25        | 2              | 23    | Accept or Reject | 25 to 27      |
| Totals =           |   | 95        | 12             | 83    |                  |               |

Submit

Done

Trusted sites 100%





Note. At end of round Manager (AO) learns results. Whether offers were accepted and round payoff depending in the setting in effect (baseline, share of savings bonus, tournament, and so on). The setting shown is for “no positions critical” and a “share of savings bonus” paid for amount saved from billet allocation.

subjectpage\_demographics.cfm - Windows Internet Explorer

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subjectpage\_demographics.cfm

### Your Demographic Information

The experiment is over. While you are waiting for the final payoffs to be calculated, please answer these questions...

Age: No Answer

Gender: No Answer

Race: No Answer

Political Party Affiliation: No Answer

Father's Education (Please provide the highest DEGREE level completed): No Answer

Mother's Education (Please provide the highest DEGREE level completed): No Answer

Academic Year: No Answer

Major: No Answer

Grade Point Average (GPA) Overall: No Answer

Grade Point Average (GPA) for Major: No Answer

ACT Test Score (if taken): No Answer

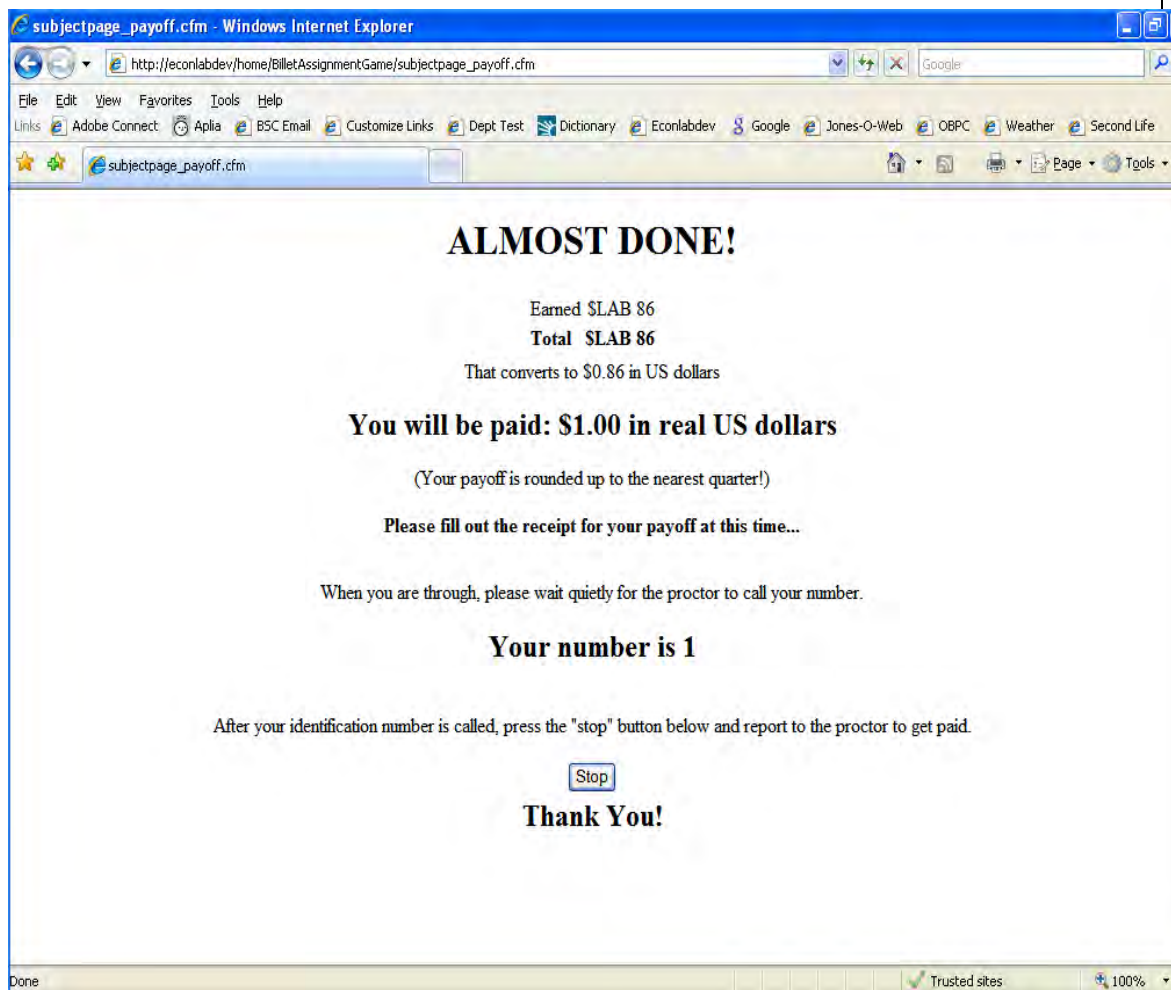
SAT Test Score (if taken): No Answer

Press "Proceed" when finished filling out this form.

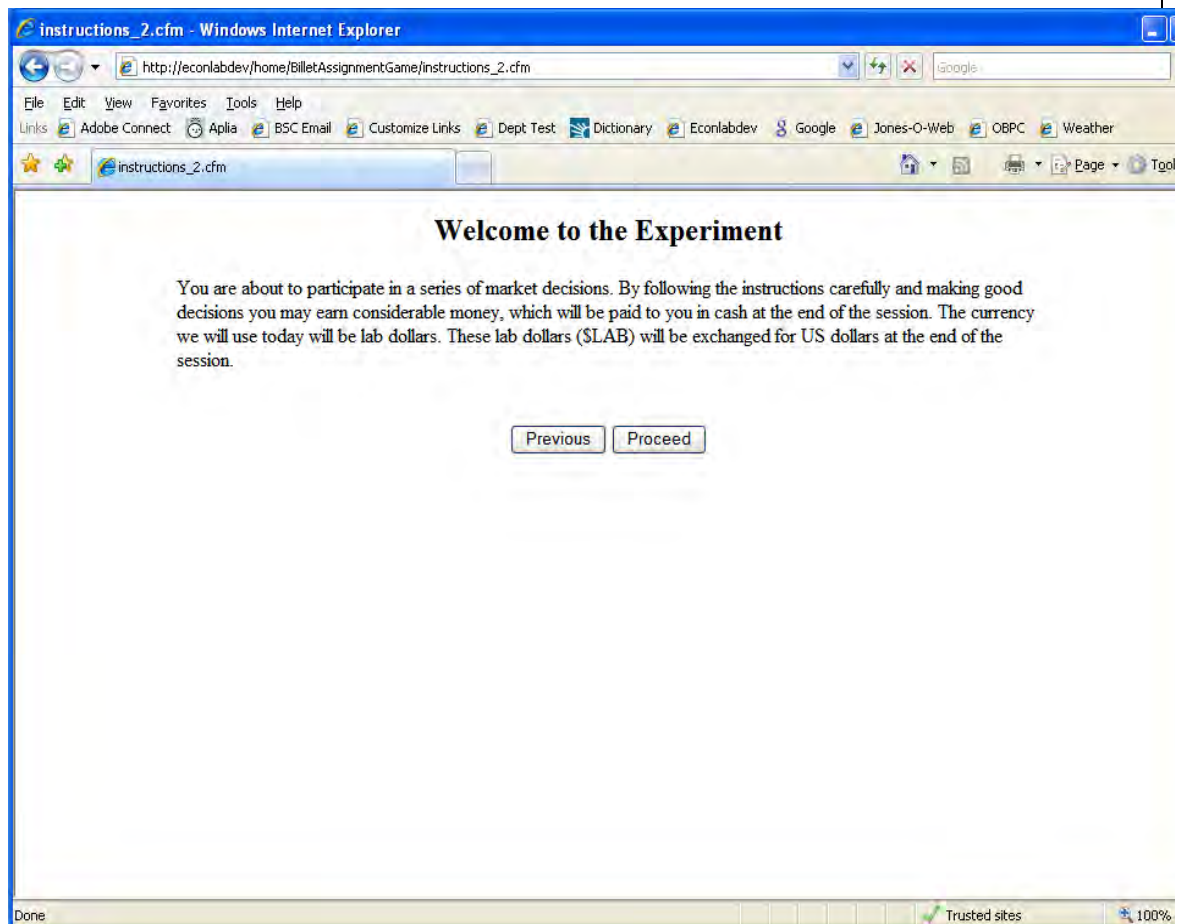
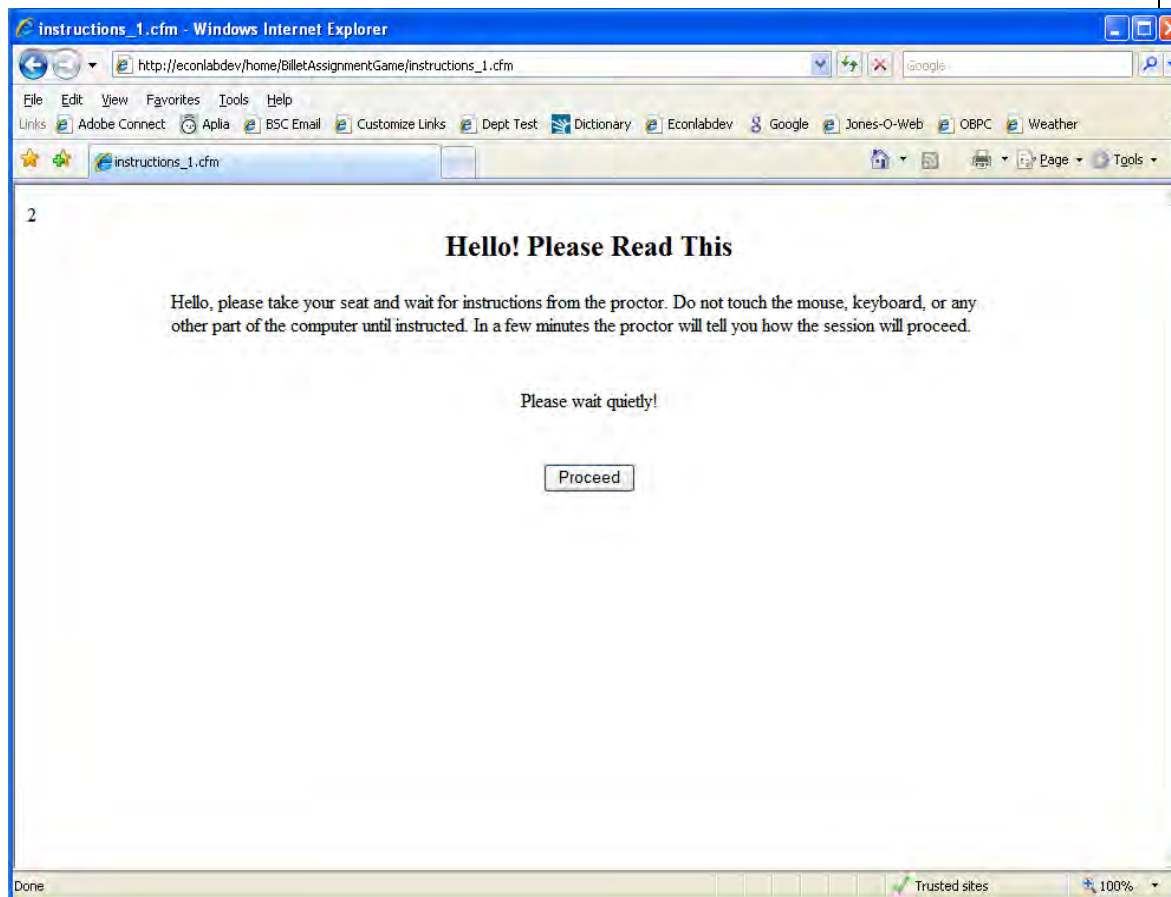
Proceed

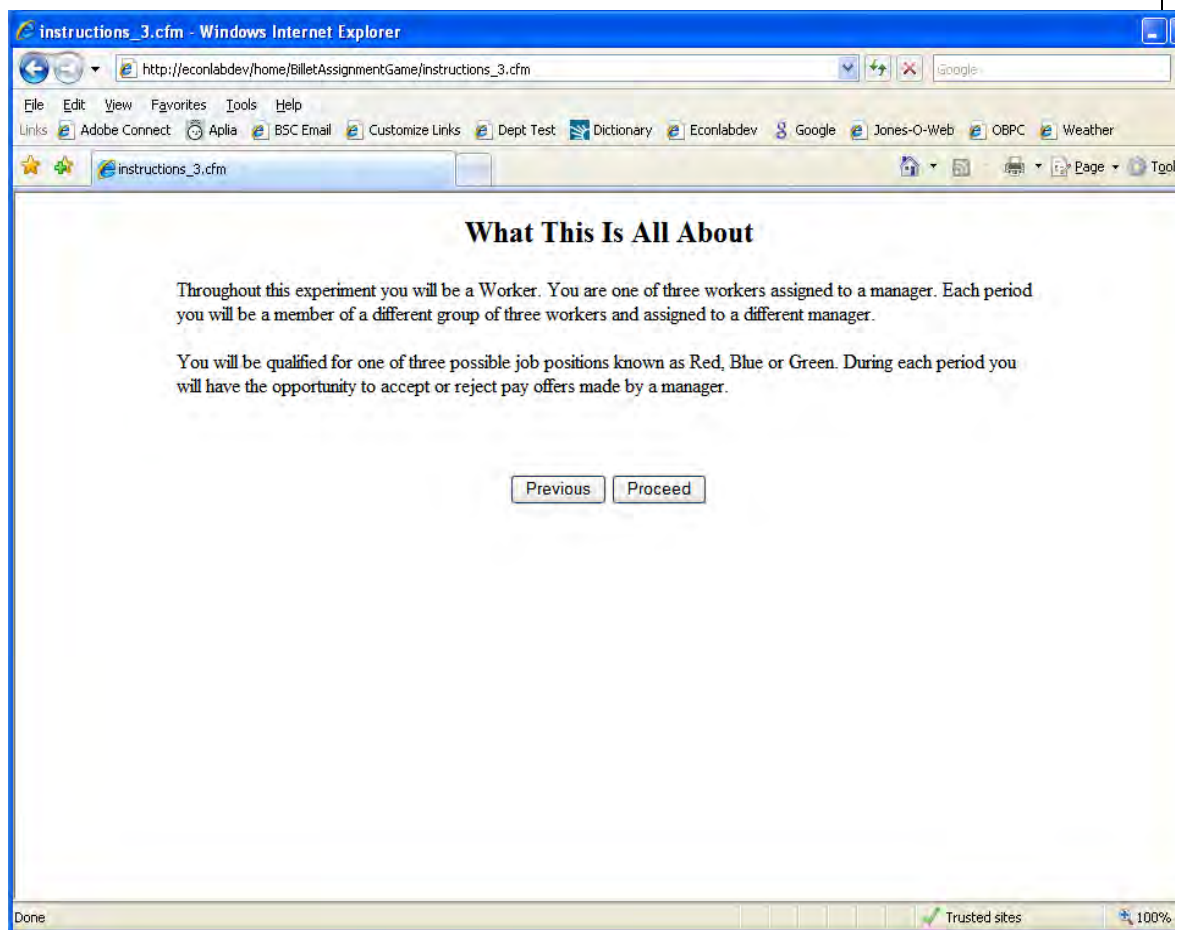
Done Trusted sites 100%

Note. some demographic information was collected at the end of the session prior to the participant being informed of earnings from the session. In accordance with IRB requirements for human subjects research, the participants are free to skip any (or all) of the questions by choosing the “No Answer” option.

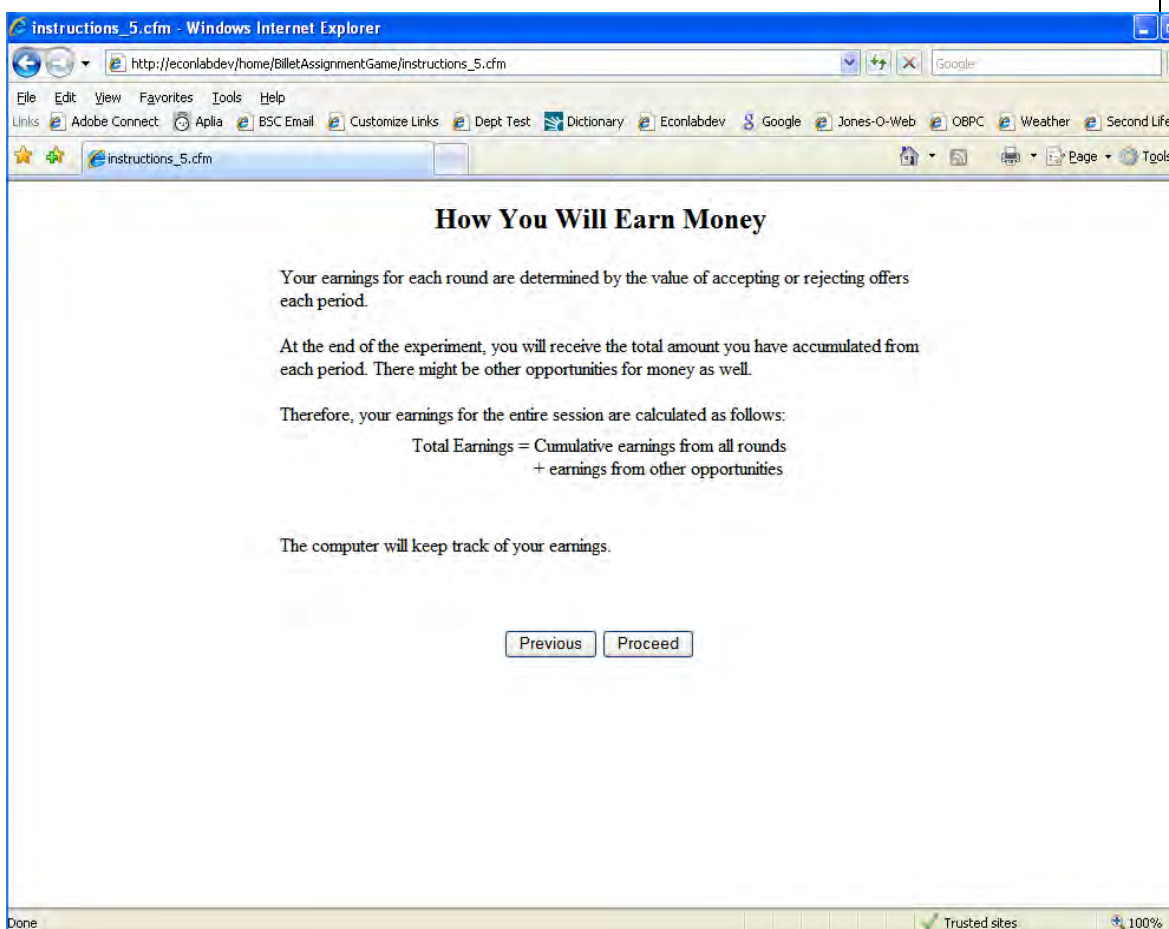
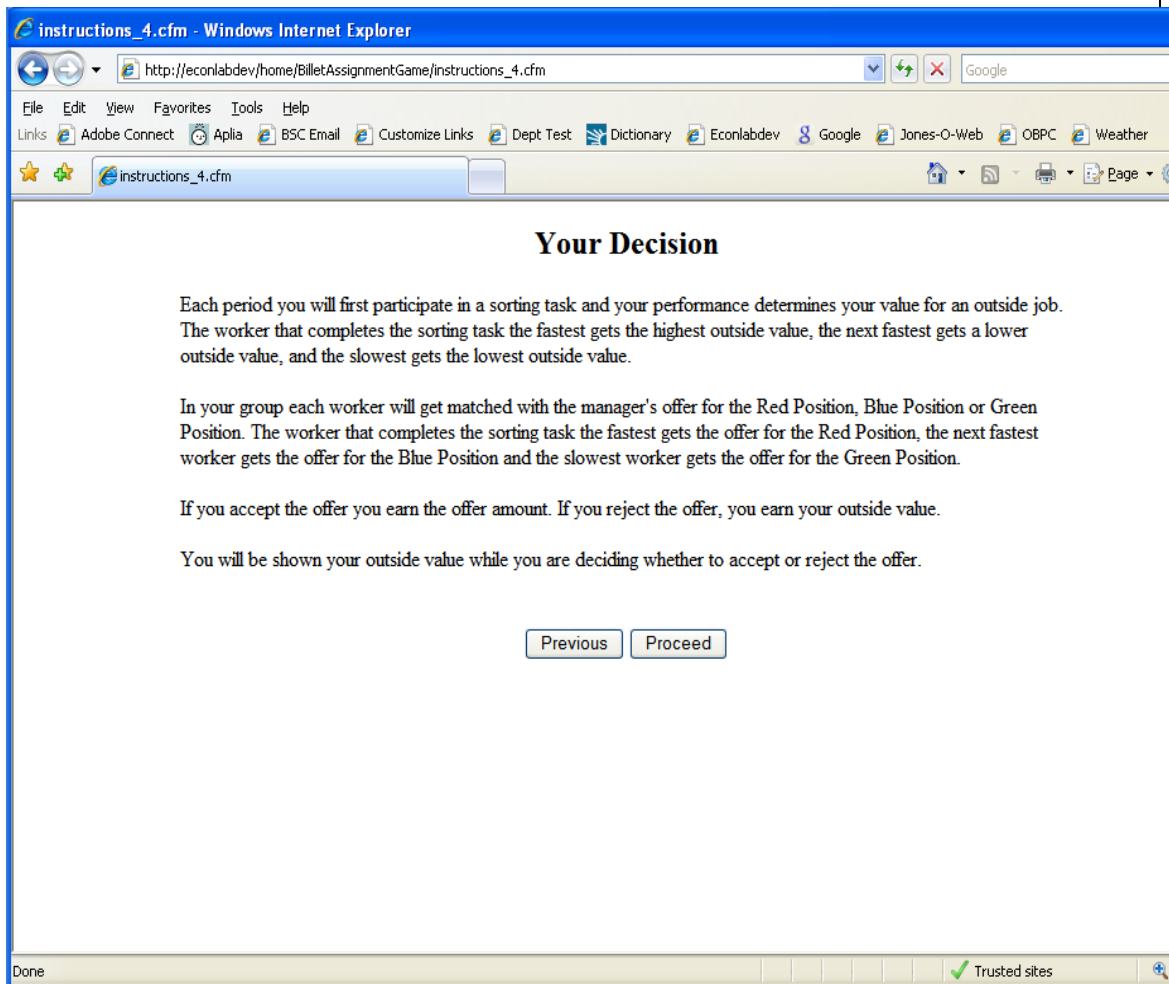


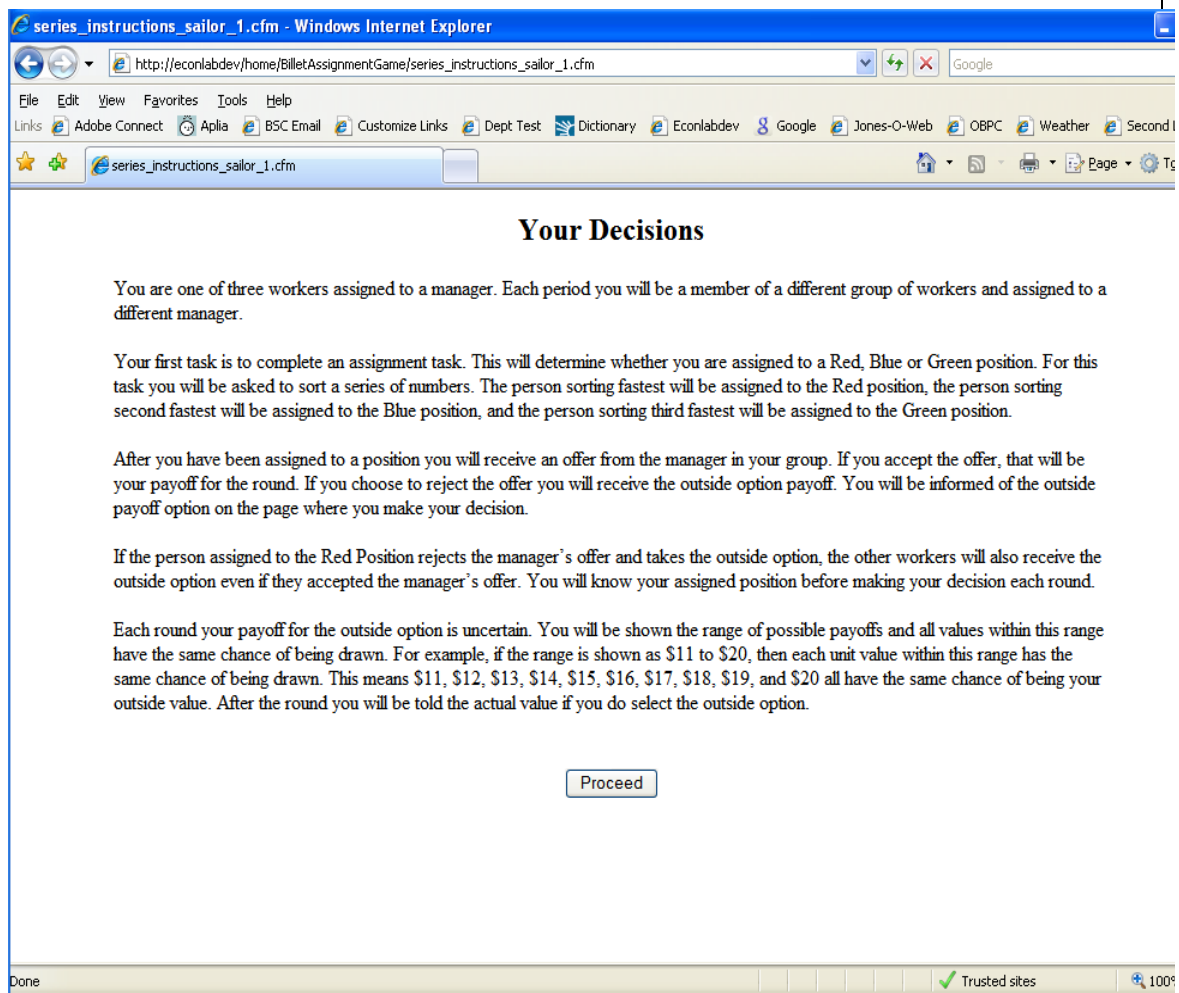
Note. Final earnings screen prior to being paid for earnings during the session. This is a screen from a pseudo run to obtain screen images. Hence the low payoff.

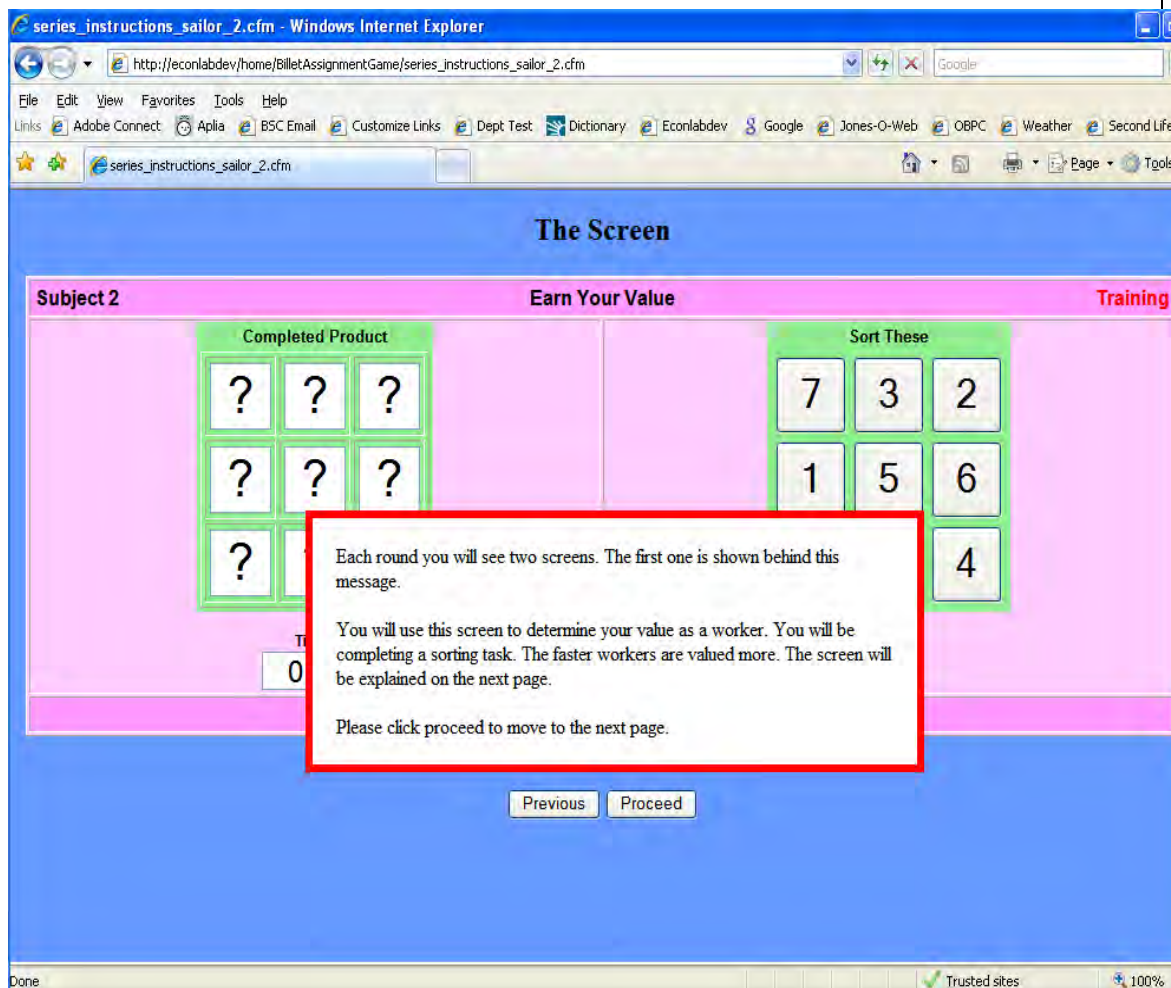




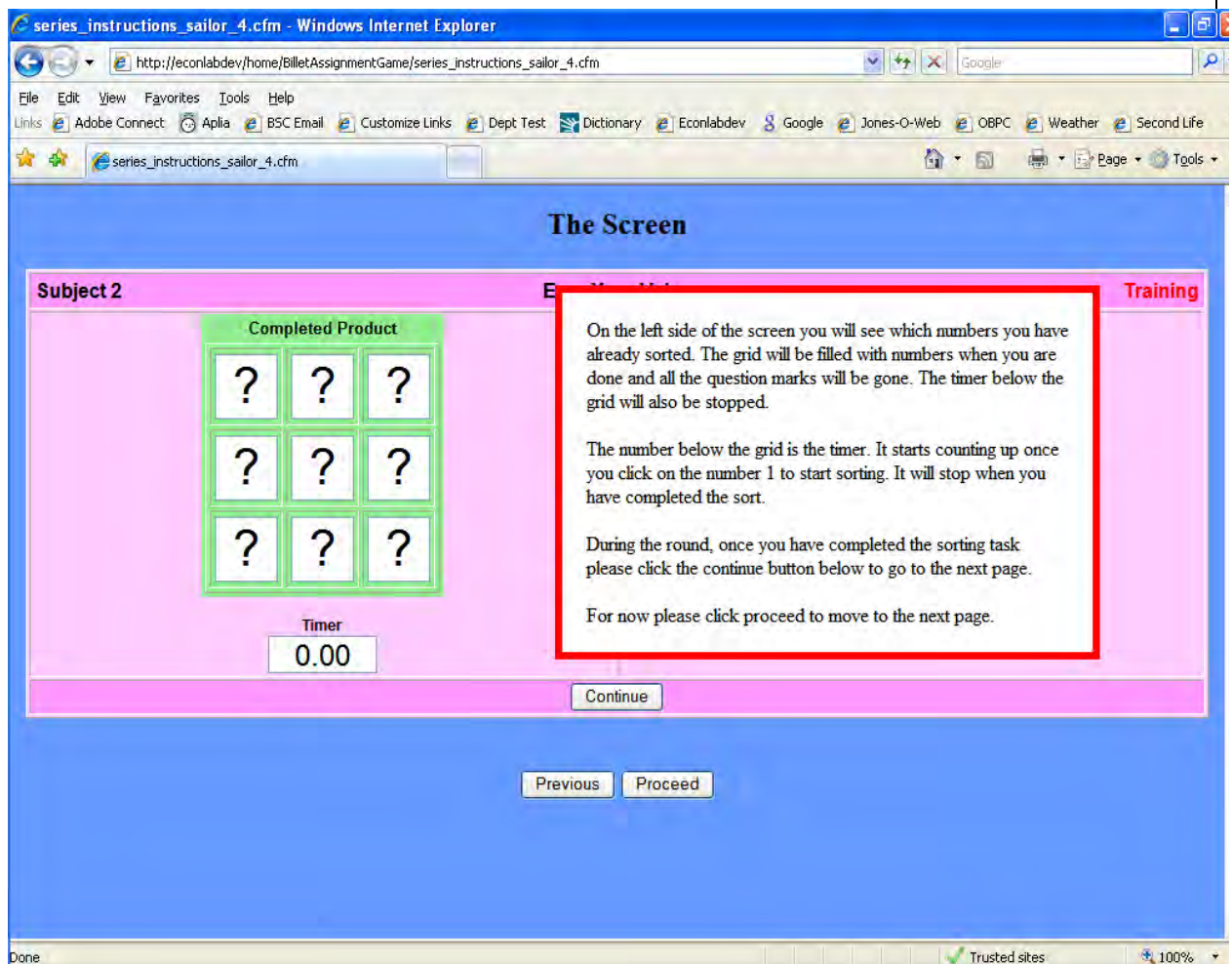
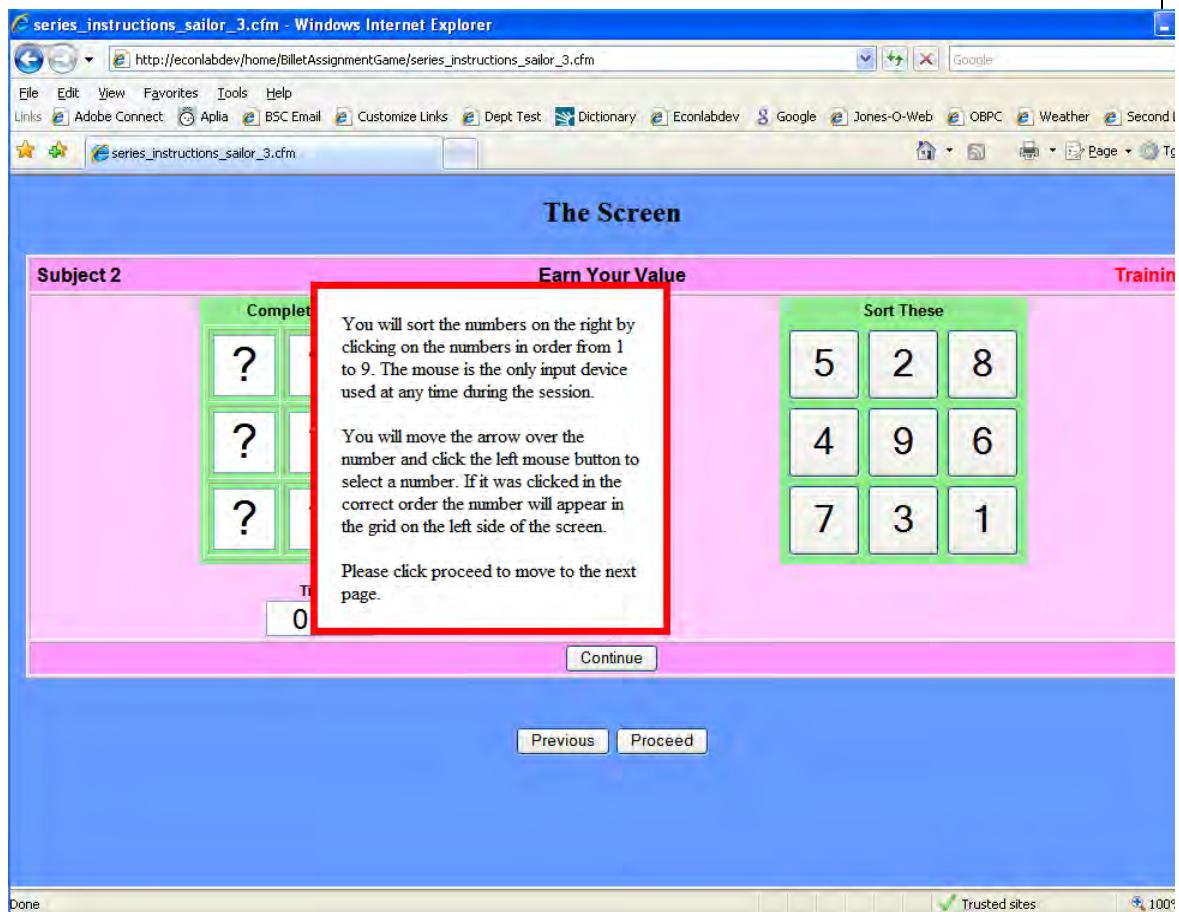








Note. Workers are assigned to Red, Blue, or Green jobs (Red is highest outside option and Green the lowest) based on relative speed of completion of the sorting task. This is an implementation of an ability ranking. This task is completed each round of the experiment.



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## The Screen

**Subject 2**

**Trainin**

**Previous Round**

|                  | Positions | Potential Save | Offer | Outside Actual | Payoff  |
|------------------|-----------|----------------|-------|----------------|---------|
| Manager's Payoff | xxx       | xxx            | xxx   | xxx            | YOU xxx |
| Pay              | xxx       | xxx            | xxx   | xxx            | xxx     |
| Bonus            | xxx       | xxx            | xxx   | xxx            | xxx     |
| Total            | xxx       | xxx            | xxx   | xxx            | xxx     |

Manager's Budget xxx

The main screen you will use during each round will have a variety of information. It is shown behind this message and will be explained in detail over the next few pages.

Please click proceed to move to the next page.

**Current Round**

Manager's Budget 95

|          |    |    |   |                  |               |
|----------|----|----|---|------------------|---------------|
|          | 30 | 30 | 0 | Accept or Reject | Outside Range |
|          |    |    |   |                  | 40 to 42      |
|          | 25 | 25 | 0 | Accept or Reject | 30 to 32 YOU  |
| Totals = | 95 | 95 | 0 |                  | 25 to 27      |

Previous Proceed

Done Trusted sites 100%



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## The Screen

**Subject**

You will use the "Accept" and "Reject" buttons to make your choice. Once you click one of these buttons the choice will be recorded and cannot be changed.

Please click proceed to move to the next page.

| Manager's Budget | Pay | Bonus | Total | Manager's Budget | Pay | Bonus | Total | Manager's Budget | Pay | Bonus | Total | Manager's Budget | Pay | Bonus | Total | Manager's Budget | Pay | Bonus | Total |
|------------------|-----|-------|-------|------------------|-----|-------|-------|------------------|-----|-------|-------|------------------|-----|-------|-------|------------------|-----|-------|-------|
| XXX              | XXX | XXX   | XXX   | XXX              | XXX | XXX   | XXX   | XXX              | XXX | XXX   | XXX   | XXX              | XXX | XXX   | XXX   | XXX              | XXX | XXX   | XXX   |
| XXX              | XXX | XXX   | XXX   | XXX              | XXX | XXX   | XXX   | XXX              | XXX | XXX   | XXX   | XXX              | XXX | XXX   | XXX   | XXX              | XXX | XXX   | XXX   |
| Totals =         |     |       |       | XXX              | XXX |       |       |                  | XXX |       |       |                  | XXX |       |       |                  |     |       |       |

### Current Round

| Manager's Budget | Positions | Potential Save | Offer | Accept or Reject | Outside Range |
|------------------|-----------|----------------|-------|------------------|---------------|
| 95               | 40        | 40             | 0     | Accept or Reject | 40 to 42      |
|                  | 30        | 30             | 0     | Accept or Reject | 30 to 32 YOU  |
|                  | 25        | 25             | 0     | Accept or Reject | 25 to 27      |
| Totals =         |           | 95             | 95    | 0                |               |

Done Trusted sites 100%

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## The Screen

**Subject 2** Training

**Previous Round**

|  | Positions        | Potential Save | Offer                | Outside Actual | Payoff |     |       |     |     |       |     |                      |             |
|--|------------------|----------------|----------------------|----------------|--------|-----|-------|-----|-----|-------|-----|----------------------|-------------|
| <table border="1" style="font-size: small;"> <tr><td colspan="2">Manager's Payoff</td></tr> <tr><td>Pay</td><td>XXX</td></tr> <tr><td>Bonus</td><td>XXX</td></tr> <tr><td>Total</td><td>XXX</td></tr> </table><br>Manager's Budget xxx | Manager's Payoff |                | Pay                  | XXX            | Bonus  | XXX | Total | XXX | XXX | → XXX | XXX | ← Accept or Reject → | XXX YOU XXX |
|  | Manager's Payoff |                |                      |                |        |     |       |     |     |       |     |                      |             |
|  | Pay              | XXX            |                      |                |        |     |       |     |     |       |     |                      |             |
|  | Bonus            | XXX            |                      |                |        |     |       |     |     |       |     |                      |             |
| Total  | XXX              |                |                      |                |        |     |       |     |     |       |     |                      |             |
| XXX  | → XXX            | XXX            | ← Accept or Reject → | XXX XXX        |        |     |       |     |     |       |     |                      |             |
| XXX  | → XXX            | XXX            | ← Accept or Reject → | XXX XXX        |        |     |       |     |     |       |     |                      |             |
| Totals =   |                  | XXX            | XXX                  | XXX            |        |     |       |     |     |       |     |                      |             |

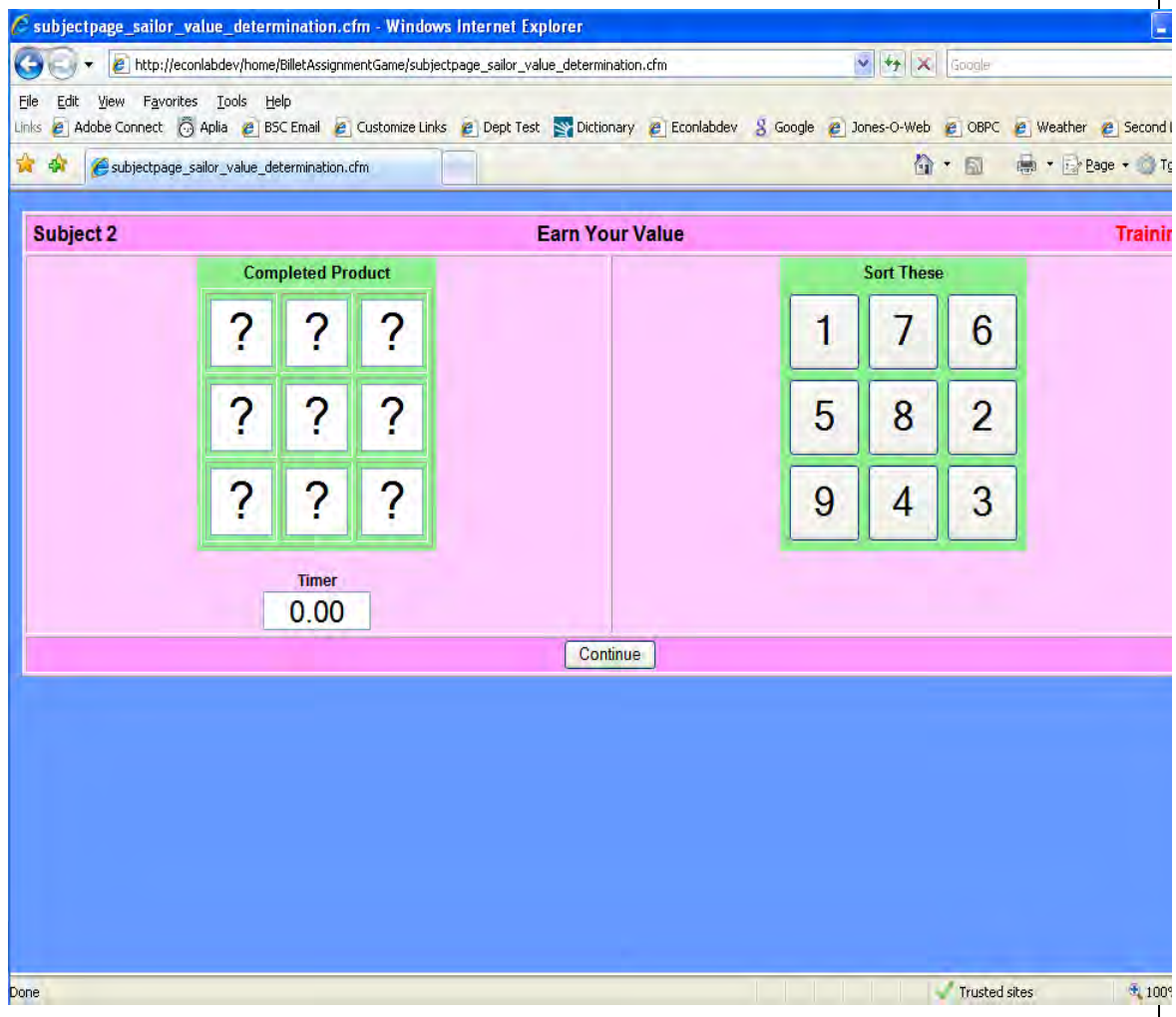
**Current Round**

On the upper part of the screen you will see information about the previous round. It will show you how your decision worked out.

Please click begin to move to the next screen and begin the round.

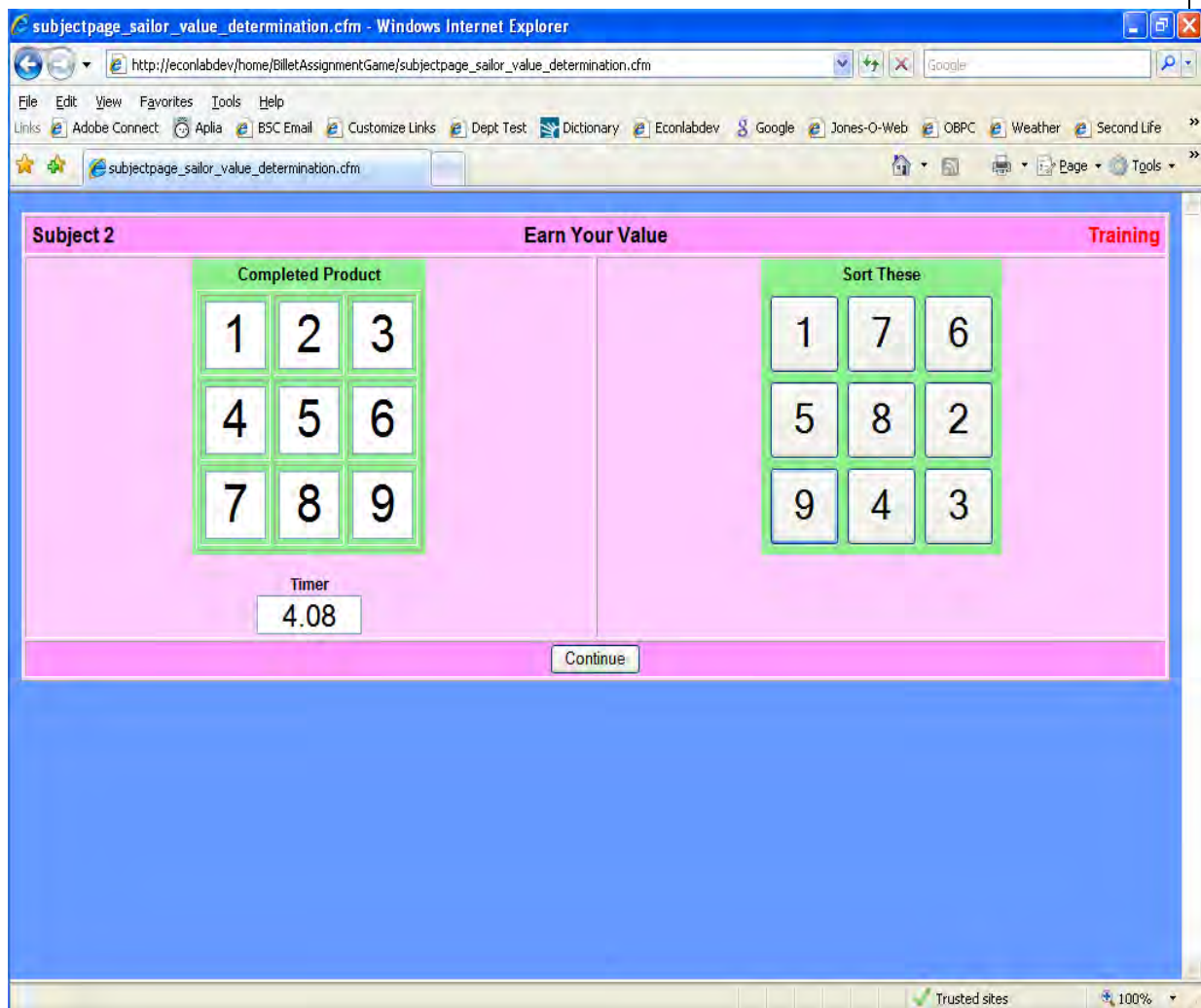
|                     |    |      |    |                      |              |
|---------------------|----|------|----|----------------------|--------------|
| Manager's Budget 95 | 25 | → 25 | 0  | ← Accept or Reject → | 40 to 42     |
|                     | 25 | → 25 | 0  | ← Accept or Reject → | 30 to 32 YOU |
| Totals =            |    | 95   | 95 | 0                    | 25 to 27     |

Done Trusted sites 100%



Note. When the instructions are completed there is a training round (or rounds). The pop-up boxes are gone and the participants make decisions exactly as would be seen in the real rounds that determine the earnings. This is true for the participants in both roles (Sailor and AO).





subjectpage\_sailor\_choice.cfm - Windows Internet Explorer

http://econlabdev/home/BilletAssignmentGame/subjectpage\_sailor\_choice.cfm

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subjectpage\_sailor\_choice.cfm

**Subject 2** Training

**Previous Round**

| Manager's Payoff |     | Positions | Potential Save | Offer | Outside Actual | Payoff  |
|------------------|-----|-----------|----------------|-------|----------------|---------|
| Pay              | XXX | xxx       | xxx            | xxx   | xxx            | YOU xxx |
| Bonus            | XXX | xxx       | xxx            | xxx   | xxx            | xxx     |
| Total            | XXX | xxx       | xxx            | xxx   | xxx            | xxx     |
| Totals =         |     | xxx       | xxx            | xxx   |                |         |

Manager's Budget xxx

Accept or Reject

**Current Round**

| Positions | Potential Save | Offer | Outside Range |
|-----------|----------------|-------|---------------|
| 40        | 5              | 35    | 40 to 42      |
| 30        | 5              | 25    | 30 to 32      |
| 25        | 2              | 23    | 25 to 27      |
| Totals =  | 12             | 83    |               |

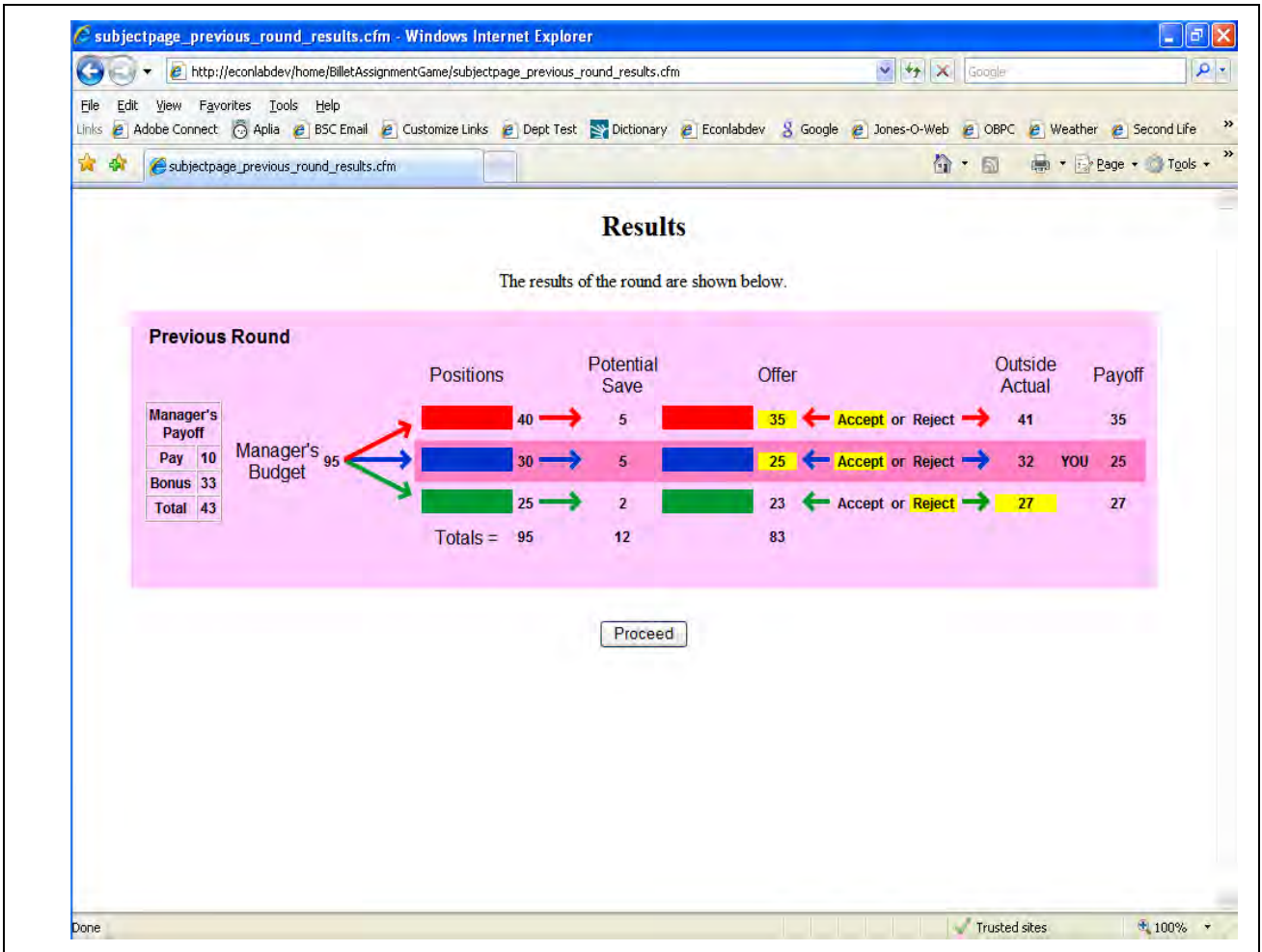
Manager's Budget 95

Accept or Reject

YOU

Done

Trusted sites 100%



Note. At the end of the round, the Workers (Sailors) are informed of the decisions of the three Workers assigned to the Manager (AO).

The participants assigned the Worker (Sailor) role respond to the same demographic questionnaire as those assigned the Manager (AO) role and receive the same final screen showing earnings. All earnings are private information in accordance with the precepts of experimental economics.

subjectpage\_demographics.cfm - Windows Internet Explorer

http://econlabdev/home/BilletAssignmentGame/subjectpage\_demographics.cfm

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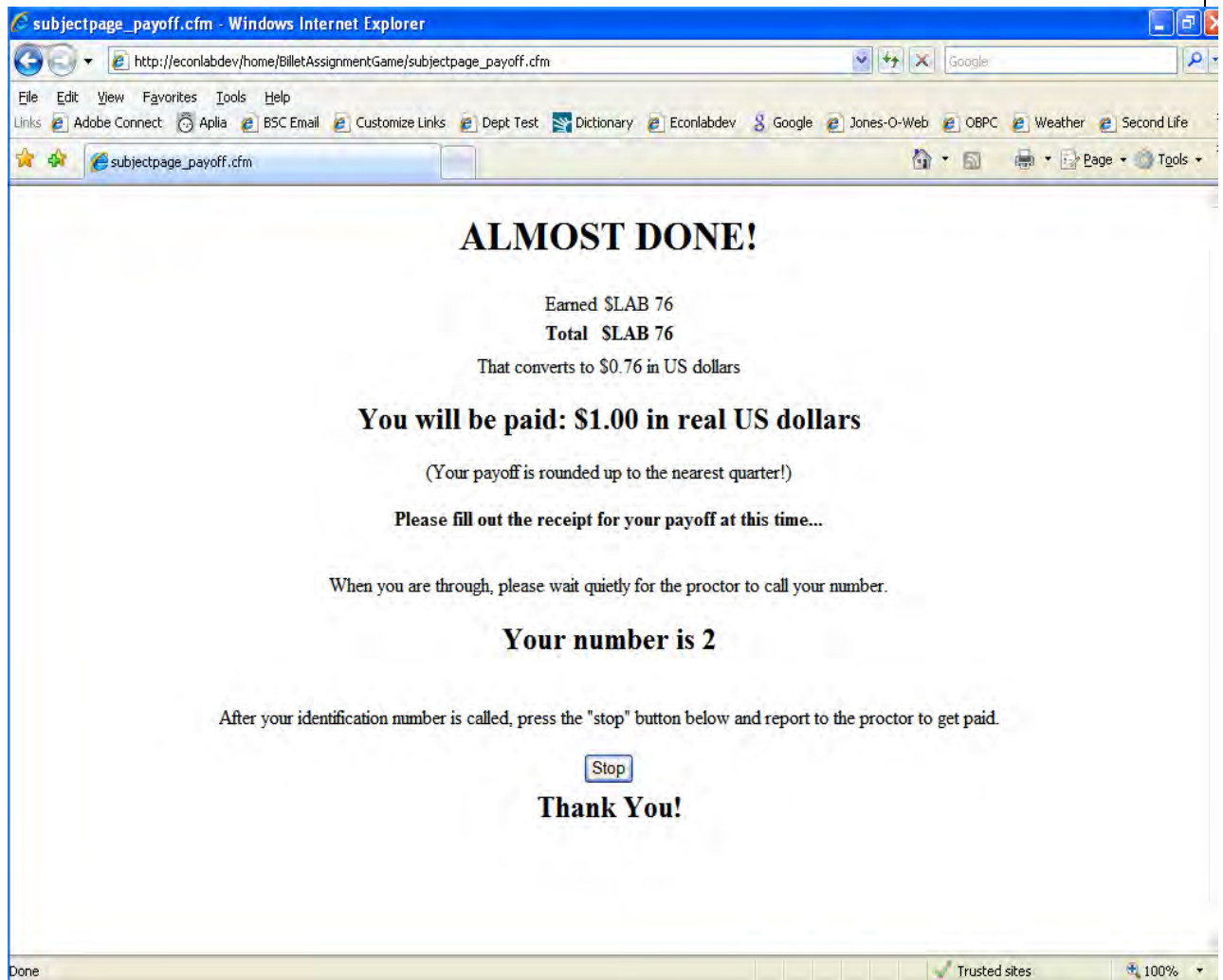
subjectpage\_demographics.cfm

### Your Demographic Information

The experiment is over. While you are waiting for the final payoffs to be calculated, please answer these questions...

|   |           |
|---|-----------|
| Age:  | No Answer |
| Gender:   | No Answer |
| Race:   | No Answer |
| Political Party Affiliation:  | No Answer |
| Father's Education (Please provide the highest DEGREE level completed): | No Answer |
| Mother's Education (Please provide the highest DEGREE level completed): | No Answer |
| Academic Year:  | No Answer |
| Major:  | No Answer |
| Grade Point Average (GPA) Overall:                                      | No Answer |
| Grade Point Average (GPA) for Major:                                    | No Answer |
| ACT Test Score (if taken):  | No Answer |
| SAT Test Score (if taken):  | No Answer |
| Press "Proceed" when finished filling out this form.                    |           |
| <input type="button" value="Proceed"/>                                  |           |

Done Trusted sites 100%



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